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ABSTRACT

This social studies unit includes a teaching guide, student text, study guide, teacher background material, and composite pretest/posttest covering archaeological methods, evolution, fossils and man, and development of culture during the prehistoric periods in the Old World. It is part of the Anthropology Curriculum Project and is designed for grade 5. The unit objective is to provide students with a background for understanding man and his culture. Subject material is divided into four sections: a discussion of archaeologists and their methods, evolution and subsequent scientific theories, the development of fossil man, and technological advances made during prehistoric periods. The teacher's guide suggests lesson plans for the unit, listing vocabulary, objectives and content, activities, review questions, educational media, and definitions. Drawings, maps, and charts illustrate the pupil text. The pupil's study guide introduces each subject, lists key words and ideas, suggests activities, encourages independent thinking by asking questions not answered in the text, and offers review questions. A glossary and 181 completion exercise sentences conclude the section. The teacher background materials examine the subjects in detail, including charts, maps, and bibliographies. A composite form for the pretest/posttest consists of fifty multiple-choice questions. (CK)

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The Development of Man and His Culture:
Old World Prehistory

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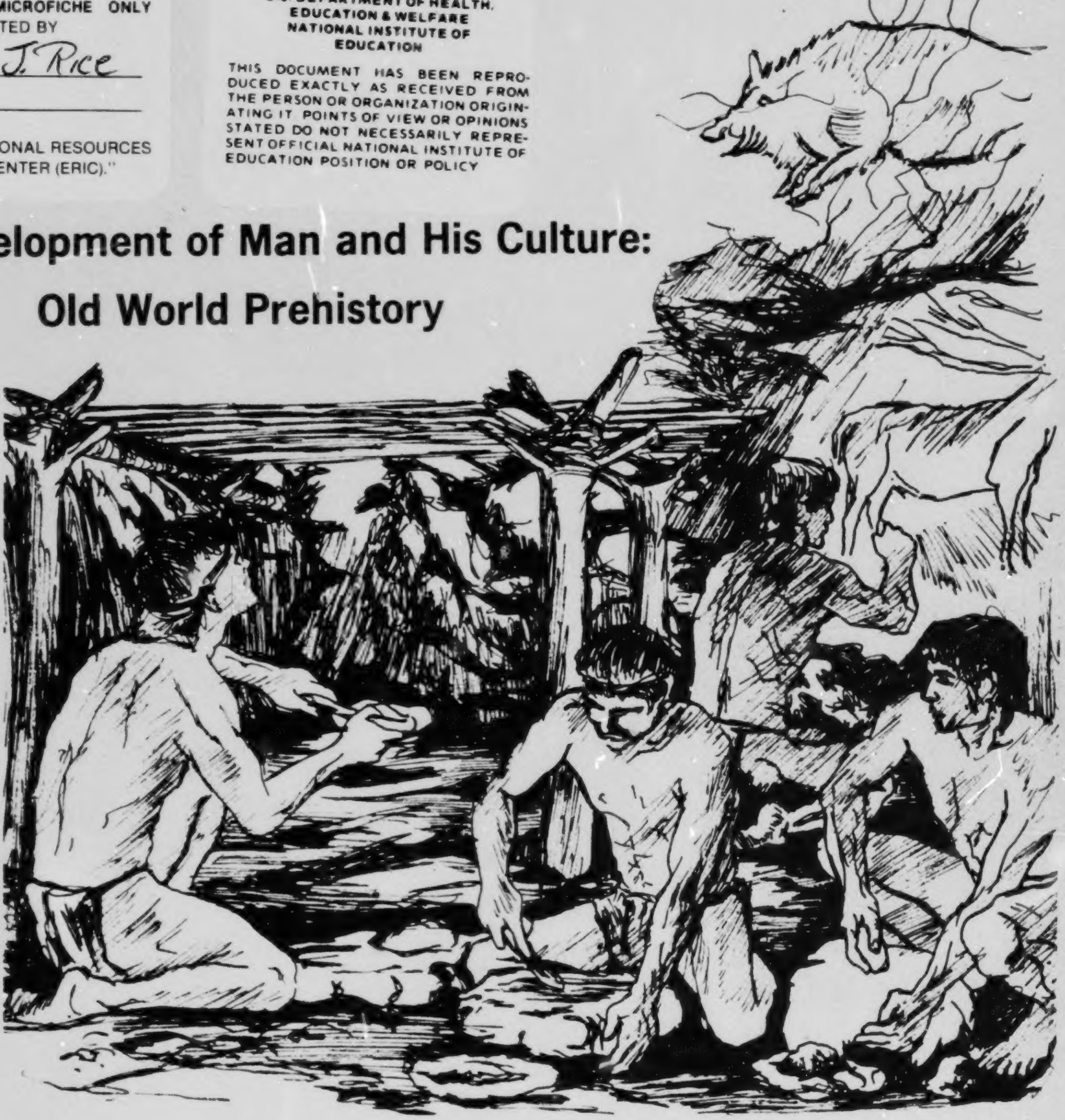

SO 011 798

TEACHER GUIDE: Grade Five

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Under the supervision of Oscar T. Jarvis

Publication No. 25 / Anthropology Curriculum Project / University of Georgia
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VOCABULARY (GLOSSARY)

DEVELOPMENT OF MAN AND HIS CULTURE

GRADE FIVE

INTRODUCTION

A. Objective

The objective of this unit is to build a background for the understanding of the development of man and his culture.

The four general objectives of the unit on the "Development of Man and His Culture" are:

1. To gain some insight into the methods of the archeologist and the contributions of his work to the understanding of early man.
2. To learn that evolution is descent with modification or change through time.
3. To acquire an idea of the various fossils which have been found and their relation to the line which ultimately produced modern man.
4. To obtain a general idea of development of culture during periods of Old World Prehistory.

B. Rationale of the Anthropology Curriculum Project

The construction of the curriculum in anthropology by the Anthropology Curriculum Project at the University of Georgia is based upon several premises, among which are:

1. Any field of knowledge, such as anthropology, consists of a system of symbols, or word labels which are used to express ideas and describe relationships. An understanding or mastery of any field of knowledge begins with an understanding of the symbol system, the meaning of which expands and develops as the knowledge of the discipline is extended.
2. Symbol systems are usually organized for transmission of a core of congruent ideas, usually referred to as subject matter, discipline, or field. For almost thirty years the social studies movement has contended that a subject approach to the transmission of social studies is inappropriate for the elementary grades. It is thought that any

type of organization of material, irrespective of its method, is designed to transmit knowledge, and that there is nothing incompatible, except preference and tradition, with a subject presentation of a social science in the elementary grades.

3. Anthropological material is frequently used in the public school, but in the absence of emphasis on anthropological concepts and terminology, the contribution that anthropology has to make to an understanding of man and of different cultures is frequently obscured. The material in this unit deliberately introduces anthropological terminology which may at first be somewhat difficult for the student. As his familiarity with these terms increases, however, it is expected that these terms will help him to organize and interpret in a more meaningful manner the world in which he lives.

C. Vocabulary

Anthropology, like any field of study, uses many terms. Some of these terms are new words that have been introduced into our language by the anthropologist. Some of these new words have been taken from the languages of the people, studied by anthropologists, and found to contain examples of the item in question. For example, "culture" is used to designate the sum total of things that man learns in common with the other members of the group to which he belongs. It is not used in the older more popular manner to designate refinement.

A Word List is included in the instructions for each lesson topic. A Vocabulary at the end of the TEACHER'S GUIDE and the PUPIL'S GUIDE defines the words. The anthropological terms in the word list and vocabulary segment of the teacher's guide have been designated by an asterisk. They are defined in the glossary section of the teacher's guide and pupil's guide. These terms have been included primarily for the benefit of the teacher and students in helping them to understand more precisely the discrete information pertaining to each topic.

The teacher should emphasize mastery of the vocabulary which is peculiar to each lesson in the student's text and introduce these terms in building readiness for the lesson, insofar as is possible. It is not intended, however, that the teacher will attempt to teach all of the anthropological terms. Only the most important terms should be selected to transmit an understanding of the various objectives as outlined in the teacher's guide. Whenever the teacher encounters marked difficulty in using a technical anthropological term, he may wish to emphasize an appropriate synonym of a simpler nature.

D. Basic Philosophy of the Materials

The material presented in this unit attempts to lead to a better understanding of the development of man and his culture. The lessons present some of the basic concepts in the Outline of Basic Concepts in Anthropology. Throughout the materials these concepts are emphasized. Learning should be based on these concepts and the factual background given to support them. The background material written for the teacher should be studied thoroughly by the teacher before an attempt is made at class presentation.

E. Appraisal

In order to evaluate the development of the pupil's comprehension of the materials presented, two tests have been prepared. A pre-test will be given before any of the lessons are taught. The pre-test is NOT a readiness test. The pre-test is given so a base may be obtained from which pupil learning may be judged. A post-test will be used to measure comprehension of the completed unit. The teacher may wish to use other forms of evaluation as a part of the daily presentation of the materials. It is suggested that a mid-unit test prepared by the teacher might help analyze pupil progress.

SUGGESTIONS FOR USING THE TEACHER'S GUIDE

The manner in which the anthropological materials are used will be of vital importance to the overall success of the Anthropology Curriculum Project. The material for the fifth grade unit, "Development of Man and His Culture: Old World Prehistory" consists of the following items:

For the Teacher:

Publication No. 24, Teacher's Background Material
Publication No. 25, Teacher's Guide

For the Pupil:

Publication No. 23, Pupil Guide
Publication No. 31, Pupil Text

Tests:

Pre-test
Post-test

The unit should require a period of approximately twenty-two school days for completion. The following schedule is recommended by the project but is not compulsory for teachers to follow. If it is followed closely, each content area of the unit will receive its proportionate share of time.

DEVELOPMENT OF MAN AND HIS CULTURE
(Grade 5)

Day(s)	No. of Days	Daily Lesson Topics
1	1	Pre-Test - Anthropology test
2	1	Pre-Test - Reading test
3-6	4	Archeological Methods
7-10	4	Evolution
11-14	3	Fossil Man
15-19	7	Old World Prehistory
20	1	Review and Summary
21	1	Post-Test - Anthropology Test

Procedure for Teaching the Unit

Although each teacher is at liberty to establish his own procedure for developing the unit, the following guide is suggested as an acceptable mode.

1. Pre-test. The pre-test must be administered on the first day in order to obtain the initial knowledge level of the children so that achievement can be measured. The pre-test will be mailed separately to the teachers to be administered to the pupils the first day the unit begins. Instructions for administering the tests will accompany them.

2. Archeological Methods. The lesson on "Archeological Methods" should take approximately four days and should follow the second day of pretesting. Teachers should study the essay on "Archeological Methods," the objectives to be accomplished, vocabulary, and the review questions contained in the teachers background material and the students guide before attempting to teach this lesson.

3. Evolution, Fossil Man and Old World Prehistory. These three topics should require about fourteen school days of teaching time. A suggested procedure for the teacher to follow is summarily listed. First, begin by reading all of the materials through, both teacher and student, to get a feel of the scope and sequence of the material to be taught. Then start with the lesson topic "Evolution." Through explanation and study of the pupil's materials, help the children to conceptualize what is meant by the term "evolution." Consult the teacher's and the pupil's guides frequently to determine if you are developing the objectives outlined there. Check also to see if you are using the vocabulary correctly. Select an

appropriate activity or activities from those listed in the guides which will enforce the desired learnings from the material. Use the review questions as an overview of the material covered and as a check to determine if additional teaching will be necessary. Move on to the next topics, Fossil Man, and Old World Prehistory and continue using a similar procedure.

4. Summary and Review. The teacher should allow one day at the conclusion of the unit to review and summarize the learning. The objectives listed in the study guide along with the review questions will provide a source of information for the teacher to use in completing this important segment of the unit. Also, the teacher may wish to have a culminating activity in which parents are invited into the room to see the displays which have accumulated during the developmental phases of the unit. At that time, children may wish to give oral reports about certain aspects of their studies. Also, the teacher is not expected to do all of the activities suggested in the pupil's guide or the teacher's guide. He should choose those which meet the needs of his students.

5. Post-test. A day should be set aside for giving the post-test in Anthropology. These materials will be mailed to teachers in time for their administration along with directions for their usage.

Daily Time Required for Teaching the Unit. "The Development of Man and His Culture" is to replace another social studies unit which would have been taught in the regular program of the school. The amount of daily time which should be allowed for the teaching of this unit will be determined by each teacher participating in the project. It is likely, however, that at least one hour per day should be allocated for the unit. It is conceivable that if pupil interest warrants, the teacher may choose to spend more than one hour daily. Also, on days when activities such as the painting of a mural or construction of a bulletin board are being done, much more time will likely be necessary.

CHAPTER I

ARCHEOLOGICAL METHODS

A. Introduction

This chapter on archeological methods gives an overview of the work of the archeologist. It describes methods and techniques used both in the field and in the laboratory. The material emphasizes archeology as a science, and is also a means to arouse interest in the entire unit. Enthusiasm created by the exciting and scientific work of the archeologist in uncovering man's past will stimulate interest in three other chapters of the unit.

This chapter is not to encourage students to try to excavate and become amateur archeologists. Much damage to archeological sites results from unscientific excavation. The chapter develops an appreciation of the science of archeology, and shows how archeology helps man to learn more about his past.

B. Vocabulary

*absolute dating
*archeology
*artifact
*calendrical dating
*carbon 14 dating
*ceremony
*chipping station
*cultural traits
*culture
dehydration
*dendrochronology
excavation
*habitation
*innovation
organic
periphery
*potassium-argon dating
*preservation
*primitive
quadrant
radioactive
*relative dating
*salvage archeology
*seriation
*site
strata
stratigraphy
*surface collection
*test pits
*test trenches

C. Objectives and Content

The objective of this section is to help children understand the methods and techniques used by archeologists in studying the past.

1. Archeology is the scientific study of the material remains of past human life and activities.

2. Archeology is important because:

    a. It sheds light on the history of man and on the course of his development.

   b. It helps us to better evaluate our own culture and understand how we came to be as we are.

3. History of archeology:

   a. Schliemann's work at Troy was the first effort at a real interrelation of archeology, history and prehistory.

   b. Man has long been interested in digging into the remains of the past. Ancient culture often recovered objects from preceding ones.

   c. The Renaissance in Europe brought about renewed appreciation of the sculptures, pottery, and other objects from the ancient cultures of Egypt, Italy, and Greece.

   d. Excavations in the early days of America were for the most part haphazard and clumsy.

   e. Only in the past hundred years has archeology become one of the recognized sciences.

4. Definition of field archeology:

   a. Field archeology is the use of scientific methods for excavating ancient materials.

   b. The historical importance of an object depends very much on its associations with other objects in context.

5. How things get buried and preserved:

   a. An accumulation of the materials discarded by man builds up in layers.

   b. Decay and soil formation cover former surface areas.

   c. Volcanic action has at times buried living areas.

   d. Destruction of a city by fire and pillage is another way things get buried.

6. Steps necessary in locating, classifying, and preparing to excavate an archeological site:

   a. Sites are located by:
      (1) chance
      (2) a careful search by an archeologist

   b. Sites are classified according to:
      (1) location
      (2) use
      (3) historical content

c. Before excavation begins certain steps are necessary, such as obtaining the permission of the owner of the land.

7. Procedure and tools necessary to excavate an archeological site:

   a. Methods of excavation include:
      (1) trenching
      (2) digging a pit
      (3) working one or more quadrants
      (4) a combination of these methods
      (5) total excavation

   b. An archeologist's tools may be any implement that seems to get the job done:
      (1) Brushes
      (2) Knives
      (3) Baskets
      (4) Screens
      (5) Shovels
      (6) Picks
      (7) Trowels

   c. After the work of digging and recording is completed, refilling the excavation may be necessary.

8. Methods used in dating an archeological site:

   a. Relative dating methods:
      (1) defined - this method does not specify which year, but indicates whether an object is older, of the same age, or more recent than another.
      (2) Examples
         (a) stratigraphy
         (b) seriation
         (c) use of past flora and fauna
         (d) geological relationships

   b. Absolute dating methods:
      (1) defined - this method gives a more or less fixed date such as A.D. 1000.
      (2) Examples
         (a) calendrical dating
         (b) dendrochronology
         (c) potassium-argon dating
         (d) carbon 14 dating

9. Interpretation of findings from an archeological site study:

   a. Placing the site in time and space.

   b. Evaluating it in relation to other sites and cultures.

c. Describing the culture traits.

d. Reconstructing the life of the people.

e. Many artifacts are lost due to deterioration.

f. Non-material traits of a culture are not recovered.

10. Publication of findings from an archeological excavation:

a. Why publication is necessary:
   (1) An unreported and unpublished excavation robs archeologists of knowledge which is sometimes irreplaceable.
   (2) Once a site has been excavated, it is usually destroyed for subsequent scientific use.

b. Characteristics of good reporting:
   (1) The report is easily understood.
   (2) It begins with a short summary and topic headings.
   (3) A review and interpretation of the findings follows.
   (4) All data is given.
   (5) Tables and pictures are used.

D. Activities - (Some activities which can be utilized to accomplish the objectives for this segment on ARCHEOLOGICAL METHODS follow. The teacher can select those most appropriate for his own classroom.)

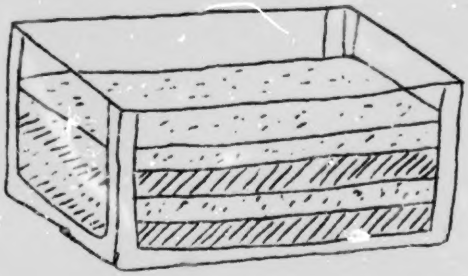
1. Activity: Develop a Model Stratification Sample of the Different Layers of the Earth's Surface

a. Purpose - To observe the earth's layers and how artifacts are deposited.

b. Material - (1) Obtain a terrarium, box with glass on the side, or a sandbox for the classroom. (2) Obtain different kinds of clay, sand, gravel, and humus, and appropriate artifacts. (The "artifacts" do not need to be ancient. They may be such items as bottle caps, broken flower pots and other small items.)

c. Procedure - (1) Secure artifacts to date the Paleolithic, Mesolithic, and Neolithic Ages. (2) As the unit progresses, add the layers of soil in the terrarium, and place in an artifact or fossil. (3) To evaluate learning on the unit, do archeological work and unearth all the materials. Discuss, on the basis of your findings, what you would know about what tools people used, their shelter, food, etc. Bring out what you could not tell about a people from the archeological excavation.

d. Illustration -



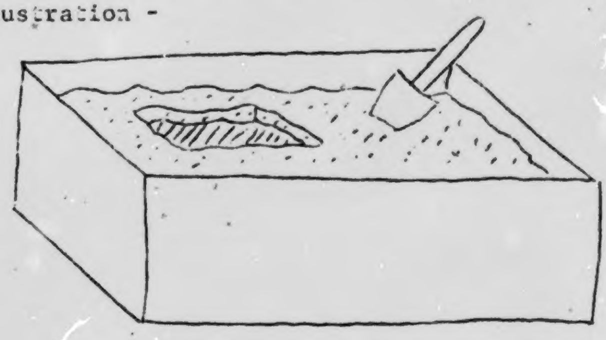
2. Activity: Techniques of Digging

   a. Purpose - To develop ideas of the methods archeologists use in digging.

   b. Materials - A box in the classroom with layers of different soil and artifacts planted in them. Tools the children could use would be tongue depressors and small paint brushes and blackboard or large piece of paper for recording results.

   c. Procedure - Have students look at the top of the ground for any clues. Excavate carefully a small test pit and record the thickness of each layer from the top to the bottom on the chart or blackboard. Then excavate each layer, recording where objects were found on the blackboard or large piece of paper. Discuss the results.

   d. Illustration -



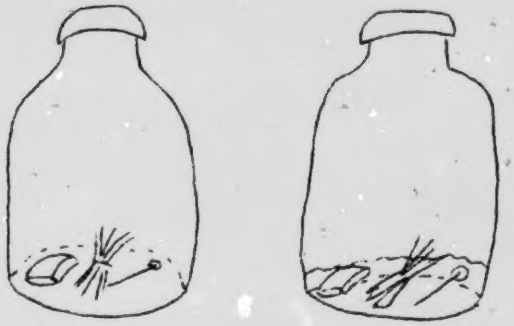
3. Activity: Preservation of Materials

   a. Purpose - To help children realize that climate and material can affect preservation.

   b. Materials - Two large glass jars with lids, some grass (organic), two non-galvanized nails (metal), and two small pieces of stone.

   c. Procedure - Place some grass, a nail, and a piece of stone in each jar. To one jar add a little water. Place the top on the jar containing water and screw on tight. The top may be put on the other jar if desired, but holes should be punched in it. Place both in sunny, dry place. Let stand about two weeks and then examine. Analyze the results.

   d. Illustration -



4. Activity: Museum Field Trip

   a. Purpose - To see actual artifacts and help children see that they are not mere fantasy.

   b. Materials - Notebooks, pencils, cameras.

   c. Procedure - Contact a museum which the school has access to and reserve a time with a guide to show children the portions of the museum relative to the material being studied. Arrange for transportation.

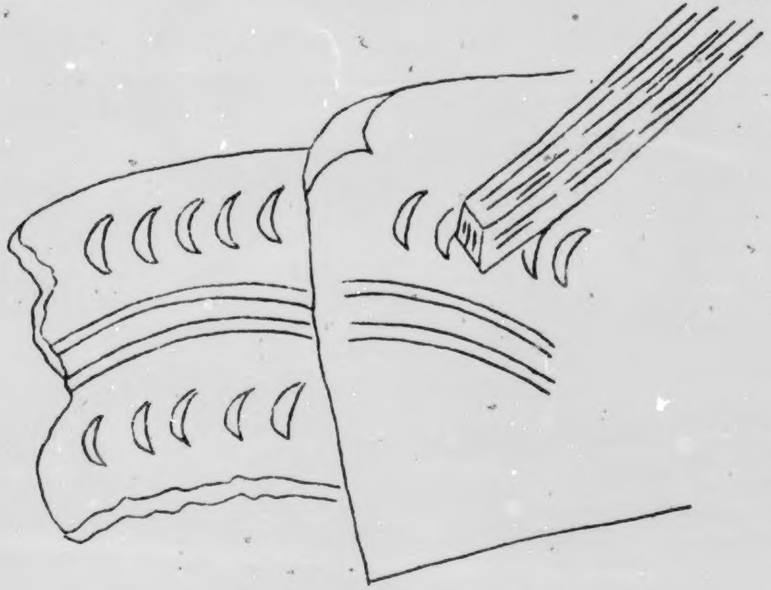
5. **Activity**: How to Take a Rubbing

   a. Purpose - To see how an archeologist uses rubbing for identification.

   b. Materials - Object with raised surface (coin-face), soft white paper, a broad point such as pencil, wax crayon or grease stick.

   c. Procedure -
      (1) Place the object you are using for the rubbing under a sheet of soft white paper.
      (2) A pencil with very broad point, a wax crayon, or a grease stick, make the best rubbing tools.
      (3) Using even strokes, mark across the paper first, then up and down. Be sure that every tiny detail comes through.
      (4) Cover the design with a heavy layer of pencil or crayon strokes, but take care not to bear down too hard. You might tear the paper.

   d. Illustration -



E. **Review Questions**

1. Suppose you visit an excavation. You find dirt, debris and artifacts scattered all about. The published results of the excavation give startling new information. Would you accept this information? Explain.

2. Suppose you found a small campsite. When you dig a test pit there you find it contains several strata of varied archeological content. How would you excavate the site? Give your reasons.

3. Why do you think archeological expeditions encourage diggers to bring their own tools?

4. What are some absolute and relative dating methods? What methods could be used to date a site in which a charred piece of wood was found in one of several strata which also contained a large extinct animal bone? How could you explain a difference in the age of the two objects?

5. How does an archeologist's training aid him in interpreting his finds?

6. Suppose a site near a stream was excavated and a water-logged object was found. What should be done immediately after the recovery of the object? Why?

7. If someone were to exoavate your house and yard 1000 years from now, what might they find? What might they not find? Would they be able to say how you lived?

F. Educational Media

1. Children's Books

Colber, Edward H.
1958 Millions of Years Ago. New York: Crowell Company.

In this book the paleontologist from Columbia University takes the reader on a fossil hunt. The methods employed by specialists in this field are well depicted.

Daugherty, C.
1962 The Great Archeologists. New York: Thomas Crowell Co.

Only parts of this book are relevant to the unit--specifically, the archeological finds made by noted archeologists. A distinction is drawn between the amateur and the professional archeologists.

Halden, R.
1960 Secrets in the Dust. New York: Dodd, Mead and Co.

This is the story of archeology. Discusses cave paintings, Egyptian tombs, the last civilizations of Central America, the accidental unearthing of prehistoric tools in American Southwest, and "City of Ivory Eyes" in Alaska.

Kubie, Nora
1957 The First Book of Archeology. New York, Franklin Watts.

The author presents the history of the development of the field of archeology. Describes the methods that an archeologist uses in locating and excavating a site. Grid method illustrated.

Mathews, William
1963 Exploring the World of Fossils. New York: Children's Press.

Discussion of the formation of the earth and the development of life. Also, methods used in identifying plant and animal fossils.

Silverberg, Robert
1963 Sunken History: The Story of Underwater Archeology. New York, Chilton Books.

Concerned with archeological finds in the Mediterranean.

2. Teacher's Books

Clark, Grahame
1964 Archeology and Society. New York: University Paperbacks.

Heizer, Robert, ed.
1959 The Archeologist at Work. New York: Harper and Brothers.

Hole, Frank and Heizer, Robert
1965 An Introduction to Prehistoric Archeology. New York: Holt, Rinehart, and Winston.

Howell, F. Clark
1965 Early Man. (Life Nature Library) New York: Time, Inc.

Poole, Lynn and Poole, Gray
1961 Carbon 14 and Other Science Methods That Date the Past. New York: McGraw-Hill.

Suggs, Robert C.
1962 Modern Discoveries in Archeology. New York: Thomas Crowell.

Wheeler, Sir Mortimer
1961 Archeology from the Earth. Baltimore: Penguin Books.

3. Subject Area Books

Ahlschwede, Ben
1963 Exploring the Old World. New York: Follett
pp. 10-29. Selection on primitive man and the contributions that archeology has made to our knowledge of him.

Bond, G. et al.
1954 How Different People Kept Their Records. Chicago, Lyons and Carnahan, pp. 189-196.

Refers to the methods used by ancient peoples to record those events which seem important to them. Mentions the paintings of cave men, and the writings of the Egyptians and Phoenicians.

Bond, G. et al.
1958 Deeds of Men. Chicago: Lyons and Carnahan.

This is a unit of stories directly related to archeology. There are definitions of related terms, illustrations of archeologists at work on sites.

Cooper, K., C. Sorenson, and P. Tod
1964 The Changing Old World. Morristown: New Jersey, pp. 9-13, 20-36. Silver Burdette, Company.

Discussion of how fossil finds give clues to the past and add to our store of knowledge of the present. Reference to beginning of civilizations.

4. Audio Visual Aids

a. Films

River Valley Archeology. (University of Georgia) Color, Sound.
Shows the work of the archeologists in creating an understanding of ancient civilizations.

b. Filmstrips

The Joint Expedition to Ur of the Chaldees. (Society for Visual Education) Black and white.

Presents map of Mesopotamia and pictures of the excavation of the Ziggurat (between the 3rd and 2nd millenniums B.C.), the Hall of Justice, and the Royal Tombs.

Fossils, Keys to the Past (Earth Science Series) 57 fr. Earth Science Curriculum Project, Lamar State College of Technology, Beaumont, Texas. Ward's, 1965.

Discovering Fossils. (Prehistoric Life) Encyclopedia Britannica Films. Color.

c. Flat Pictures

"How Old Is It," National Geographic, Vol. CIV, (August, 1958) 234-55.
Description and pictures of the apparatus used in Carbon 14 dating.

"Lascaux Cave, Cradle of World Art," National Geographic, Vol. XCIV, (December, 1948) 771-94.
Spectacular photographs of cave paintings and subterranean galleries. Most are in color.

"Last Moments of the Pompeians," National Geographic, Vol. CXX, (November, 1961) 651-69.
Excellent article and illustrations of the excavation methods and restoration procedures used at Pompeii.

"Lifelike Man Preserved 2,000 years in Peat," National Geographic, Vol. CL (March, 1954) 419-49.
Photographs of the life-like preservation from a peat bog.

"Russell Cave: New Light on Stone Age Life," National Geographic, Vol. CXIII (March, 1958) 439-47.
Good illustrations of the excavation of the site.

"Vineland Ruins Prove Vikings Found the New World," National Geographic Vol. CXXVI (November, 1964) 708-34.
Pictures of objects being unearthed (in context) from a Viking burial ship. Restored Oseberg ship is shown.

"Wetherill Mesa Yields Secrets of the Cliff Dwellers," National Geographic, Vol. CXXV (February, 1964) 196-212.
Clear photographs of the excavation and restoration of objects from the site.

Note: Other pictures of archeological methods may be found in articles listed under "Flat Pictures" for "Fossil Man" and "Old World Prehistory" sections.

CHAPTER II

EVOLUTION

A. Introduction

Evolution is one of the great concepts of modern science, and has had a tremendous impact on the social sciences as well as many branches of the natural sciences other than biology. The key idea--that evolution is gradual change through time--has been applied by such diverse fields as social philosophy and law. In this chapter, however, the discussion of evolution is restricted to organic evolution, the evolution of plants and animals.

The chapter "Evolution" presents some of the basic historical developments in science which show the convergence of ideas which culminated in Darwin's explanation of natural selection. It also gives a narrative of events which stimulated the thinking and research of Darwin. Darwin did not begin with a pre-determined hypothesis--it emerged as a result of his own field work and research and as he interpreted these in the light of other investigations. The chapter also shows, in the lack of knowledge of Mendel's work, how scientific ideas often must be rediscovered. This is a problem of all scientific research today--how to find out what other investigators have already discovered.

The chapter concludes with a summary of scientific developments since the time of Darwin--particularly genetics and mutations--which have contributed to a composite, or synthetic, explanation, of evolution.

The chapter on evolution will help students to understand better the chapter on "Fossil Man" which summarizes the physical development of man. The concept of evolution is basic for children to understand that man, as we think of him today, did not appear fully developed. The story of man is but a part of the ageless story of the emergence of life on the planet Earth and the change in this life through time.

B. Word List

*adaptation
chromosomes
comparative anatomy
cross
ecology
fossils
gene
*gene pool
*genetic drift
genus
*generalized animal
*genotype
geology
heredity
*isolation
Malthusian principle
*migration
mutation
natural selection
organic evolution
paleontology
*phenotype
placentals
*population
superpositional stratigraphy
*specialized animal
species
Theory of Uniformatarianism
variation
vertebrate

C. Objectives and Content

The primary objective of this section is to help children understand that animals and plants change gradually through time.

1. The idea of evolution as a scientific fact has resulted from the work of many men over a long period of time.
    - a. Linnaeus devised a system of classifying plants and animals.
    - b. Georges Cuvier published one of the first books in which the anatomy of various animals was compared. Credit for making paleontology a distinct science is shared by the anatomist Cuvier and the geologist Smith. (see below)
    - c. William Smith pointed out the fundamental principle that the bottom layers of rock are oldest and deposited before the rocks covering them.
    - d. James Hutton postulated that the forces operating on the earth were the same forces that had always operated on the earth, and that large changes took place over long periods of time.
    - e. Charles Lyell presented a synthesis of geologic evidence in support of the theory that the earth is very old and that the forces which shaped it are still in operation.
    - f. Charles Darwin pointed out that natural selection influences changes in organisms over periods of time.
    - g. Alfred Wallace independently came to the same conclusions as Darwin.
    - h. Thomas Malthus' idea that human population increases at a faster rate than food production and certain checks necessarily limit the human population influenced Darwin's thinking.
    - i. Gregor Mendel discovered that heredity operates according to the mathematical laws of probability.
2. Evolution is a slow on-going process.
    - a. Changes in man, animals and plants take place very slowly.
    - b. Changes are always taking place.
    - c. There are no specific ultimate goals of changes.

3. Many factors influence organic evolution. Two of these factors are mutation and natural selection.

    a. Mutations are changes in the chemical structure of a gene. When a gene mutates, it becomes a different or "new" gene.

    b. The mutation may or may not be observable in the organism.

    c. The mutation may prove an asset, a liability, or have no effect on the organism.

    d. Natural selection operates to increase the number of an organis which has an advantage in survival in the environment, providing the organism leaves a comparable number of offspring.

4. Several other factors such as genetic drift, isolation and migration also influence the evolutionary process.

    a. Genetic drift results from the accidental loss of certain genes from the gene pool.

    b. Isolation may be caused by geographical barriers or biologically caused by difference in breeding habits.

    c. Migration may change a gene pool by movement of individuals into or out of a population.

5. The fossil record and the geologic time scale provide the record of the history of life on this earth and the only direct evidence of long-term evolution.

    a. Much information can be gained from the examination of fossils. However, exact reconstruction of the organism is impossible.

    b. The Geologic time scale denotes the appearance of plants and animals of increasing complexity throughout time.

6. Man first appeared over a million years ago, but he is a relative newcomer in relation to the sequence of life and the age of the earth.

    a. The earth is estimated to be about 4.5 billion years old.

    b. The first life appeared over 600 million years ago.

    c. Early man appeared on earth about 1.75 million years ago.

    (Illustration for teaching this concept:)

The Age of the Earth

The great time span of earth's history is divided into units that allow scientists to locate events in the past. The geologic time chart on page 35 of the teacher's background material shows this division of time back to 4.5 million years or more before the present.

The scale of geological time is so great that eras are divided into hundreds of millions of years. For most of us, a hundred million years is difficult to comprehend. The following comparison will give some idea of the great span of geologic time.

DECEMBER	First manlike creatures
NOVEMBER	Dinosaurs
OCTOBER	First land plants and animals
SEPTEMBER	
AUGUST	
JULY	
JUNE	
MAY	
APRIL	Fishes
MARCH	First single cell life
FEBRUARY	
JANUARY	

The total age of the earth is variously estimated by scientists to be about [illegible] to 5 billion years.

If the last two billion years are compressed into a scale of one year, we would find no life appearing until about the beginning of March in this imaginary year. These first forms of life were single-cell animals. On this scale fishes appeared in late April or May. It was October before the first land plants and land animals appeared. The millions of years during which dinosaurs roamed the earth occupy less than the first three weeks in December, after which they became extinct.

On the 30th day of December the first manlike creatures appeared. About three minutes before midnight on this last day of the year, the last of the great glaciers began to recede. About 31 seconds before midnight, December 31, the year A. D. 1 begins. The voyage of Columbus took place about 7 1/2 seconds before midnight. About 3 seconds before midnight the Declaration of Independence was signed.

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TIME SCALE

1 month = 166,666,666 years
1 day = 5,479,452 years
1 hour = 228,311 years
1 minute= 3,805 years
1 second= 63 years

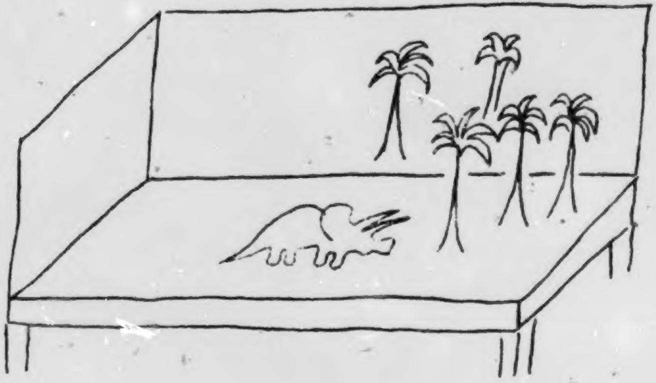
1. Activity: Diorama Showing Life in a Given Period of Prehistoric Times.

   a. Purpose - To help children become familiar with the type of life found during a certain period of prehistoric time.

   b. Materials - Sand table or other base, clay, crayons and paint, paper, paste, scissors, and cardboard. (Models of prehistoric animals may be used).

   c. Procedure - Decide on the period of prehistory to be illustrated. Check a science reference book to determine what animals were present during this period. (It is important not to mix animals from two periods, such as dinosaurs and large mammals). Construct models of the animals from the selected period and arrange them on the base (or use the plastic models). From the paper make models of the plant life that would be appropriate and place it on the base. Have the children paint or draw a background for the diorama. A diorama of geologic epochs may be constructed by assigning different periods to different work groups. The finished dioramas can then be placed into sequence to illustrate change in time.

   d. Illustration -



2. Activity: A Report on the Effect on Animals of Selection by Man.

   a. Purpose - To show children that man has changed the development of domesticated animals by selective breeding.

b. Materials - Paper, pencils, and reference books.

c. Procedure - Various animals for this report may be considered, such as horses, cattle, dogs, cats, etc. Have the children select one for a topic. Use reference books to collect information on selective breeding. Prepare an outline. Write the report. The report could be presented orally to the class.

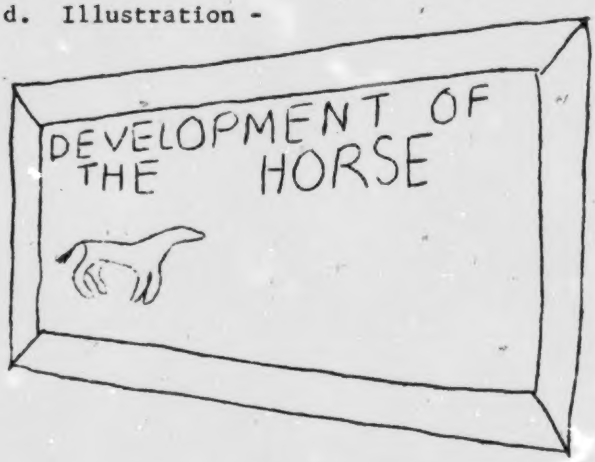
3. Activity: A Bulletin Board Showing the Development of the Horse.

a. Purpose - To present graphically the story of the development of the horse.

b. Materials - Colored paper, crayons, paint, roll of brown or white paper.

c. Procedure - From a science source book obtain pictures of the horse, from the time he was a small, three-toed animal until his present highly evolved state. Have the children draw reproductions. Mount these on the bulletin board in the correct order with approximate dates. Lettering may be cut from colored paper.

d. Illustration -



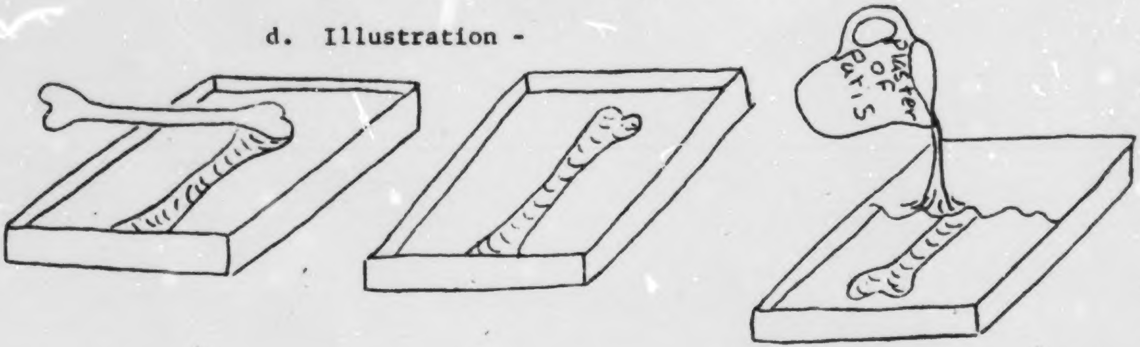
4. Activity: Making "Fossils".

a. Purpose - To help children understand how fossils might have been made.

b. Materials - Clay, plaster of paris, leaves, small bones or shell fish, and a cardboard box or shallow pan.

c. Procedure - This activity can be done in two ways. The simplest way is to have the children place some of the clay in a shallow pan, press a leaf or bone into the clay, remove the leaf and allow the clay with the impression in it to dry. An additional step may be added. If an oil base clay is used, the top half of the pan may be filled with plaster of paris after the leaf or bone is removed. When the plaster is dry it may be removed and will show a duplication of the original object.

d. Illustration -



5. Activity: Trip to a Museum to View Fossils.

   a. Purpose - To allow the children to see firsthand examples of many types of fossils.

   b. Materials - Transportation to a near-by museum, student cameras.

   c. Procedure - Make arrangements ahead of time with the director of the museum to be visited so that someone from the museum can be present to conduct the tour if possible.

6. Activity: Comparative Anatomy.

   a. Purpose - To demonstrate the significance of comparative anatomy in classification and understanding biological relationships.

   b. Materials - Source book of comparative anatomy, paper, drawing pencils.

   c. Procedure - Select a part of the anatomy, such as hand, arm, foot, leg, and draw illustrations to point out similarities and differences.

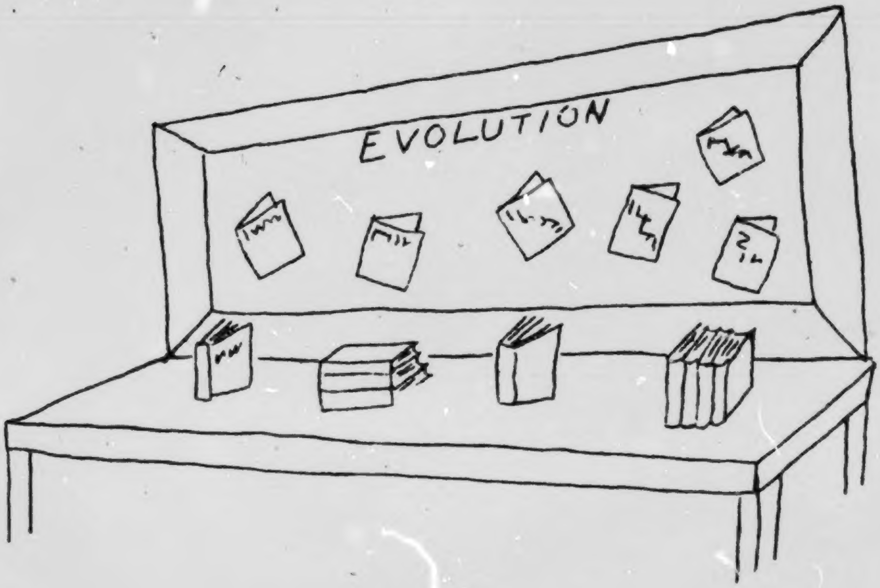
7. **Activity**: Display of Reading Materials in This Area.

   a. Purpose - To show children the reading materials available in this area and to encourage them to read from appropriate selections.

   b. Materials - Colored paper, book jackets (obtained from the librarian), bulletin board, table, a large roll of white paper, and selected books.

   c. Procedure - Cover the bulletin board with the white paper. Arrange the book jackets on the board and place the books on the table under the bulletin board. Use colored paper to make the lettering for the board.

   d. Illustration -



E. Review Questions

1. Describe your environment when you are at school; when you are outside playing. How do these environments affect you?

2. What traits have you probably inherited that make you a little different from your classmates? What traits have you inherited that make you like your parents?

3. If you received a gene for tallness from your parents, but you lived in a country where you never received enough to eat, would you grow as tall as you could? Why?

4. Do you think man is a specialized or a generalized animal? Why?

5. Many fish lay a thousand eggs or more at a time. With this high rate of reproduction, why are there not too many fish? Why is it necessary for fish to lay this many eggs?

6. Suppose you found a fossil bone of a small animal. What could this fossil tell you about that animal? What could you do to find out more about this animal?

7. Compared with the total life of the earth, man has been here only a very short time. What changes in his environment has man been able to make in the short time he has been on earth?

F. Educational Media

1. Children's Books

Fenton, Carroll
1954 Prehistoric World. New York, John Day Company.

Introduces the reader to animals of the past 350 million years. Descriptions and explanations add to the information presented in the stories, and answers the question, "How do we know that prehistoric creatures looked, lived, and acted like this?"

Knight, Charles R.
1946 Life Through the Ages. New York; A. A. Knopf.

In this book the author attempts to contrast extinct animals with those living at the present time. The animals are listed according to the periods in which they lived.

Mathews, William
1964 Exploring the World of Fossils. Chicago: Children's Press.

Discussion of the formation of the earth and the development of life. Also, methods used in identifying plant and animal fossils.

Shuttlesworth, Dorothy
1957 The Real Book About Prehistoric Life. Garden City, New York; Doubleday.

The first chapter discusses the importance of fossils in preparing a time chart of the past. Also, discusses the methods used in collecting and preparing fossils for reconstruction. The latter part of the book is devoted to discussions of early man through the Aztecs.

2. Teachers' Books

Bates, Marston
1961 "Man In Nature." *Foundations of Modern Biology Series*.

Carrington, R.
1963 *A Million Years of Man*. New York: World Publishing Company.

Dobzhansky, Theodosius
1952 *Heredity, Race and Society*. New York: Mentor Books.

1962 *Mankind Evolving*. New Haven: Yale University Press.

Eimerl, Sarel, and Irven De Vore
1965 *The Primates*. (Life Nature Library) New York: Time Inc.

Eiseley, L.
1958 *Darwin's Century: Evolution and the Men Who Discovered It*. New York: Doubleday and Company.

Lasker, G. W.
1961 *The Evolution of Man*. New York: Holt, Rinehart and Winston. Premier Books.

Lehrman, R.
1961 *The Long Road to Man*. New York: Fawcett World Library, Premier Books.

Moody, P. A.
1962 *Introduction to Evolution*. New York: Harper and Row .

Moore, Ruth
1965 *Evolution*. (Life Nature Library) New York: Time Inc.

Romer, A. S.
1933 *Man and the Vertebrates*. Baltimore: Penguin Books, Inc.

Savage, J. M.
1963 "Evolution." *Modern Biology Series*. New York: Holt, Rinehart and Winston.

Simpson, G. G.
1949 *The Meaning of Evolution.* New Haven: Yale University Press.

3. Subject Area Books

Craig and Hurley
1961 *Science Today and Tomorrow*. New York: Ginn and Company, pp. 144-163.

Classification of insects, fishes, reptiles, birds, and mammals.

Dowling, Thomas I., *et*. *al*.
1957 *The New Discovery Why*. Philadelphia: Winston Publishing Company, pp. 285-306.

Describes the formation and location of rock and mineral deposits, and the classification of each. Also included is a discussion and classification of prehistoric animals.

Dowling, Thomas I., *et*. *al*.
1957 *The New Understanding Why*. Philadelphia: Winston Publishing Company, pp. 267-280.

Discussion of the changes that animals (including man) and plants make in adapting to changes to the environment. Included is a section on the evolutionary changes of plants, insects, and marine life.

Jacobson, Lauby, and Konicek
1965 *Inquiring Into Science* . . . *Grade Five*. New York: American Book Company.

Parts of this book are of relevance to this unit. Pages 133-176 discuss the characteristics of living things, including the classification of plants and animals.

Robinson, W.
1962 *Beasts of the Tar Pits*. River Forest, Illinois: Laidlaw Brothers. Concerns the La Brea pits in California.

Evolution. Life Nature Series. New York: Time, Inc.

4. Audio Visual Aids

a. Films

Glaciers. (Gateway)

Detailed discussion of the formation of glaciers, depicting those extending from Mt. Rainier to those in Alaska. Relates the present warm era to the Ice Ages of the past.

How Living Things Change. (Coronet)

Although man is capable of effecting changes in plants and animals, all living things (including man) have themselves been slowly changing for millions of years. In this film, explanations offered for these changes are reviewed, illustrated, and compared.

b. Filmstrips:

The Age of Mammals. (Life Filmstrip Series)

Depicts the various animals that we know existed in the past. Emphasis is placed on the ancestors of modern animals.

Men of the Old Stone Age. (University of Pennsylvania, Educational Extension Series)

Begins with a chart, "Man's Place in Time," followed by a chart of the geological periods. Definitions of geology, anthropology, archeology. Discussion of Pithecanthropus eructus, Sinanthropus, and Piltdown Man (does not dispute the latter). Also included are the Heidelberg Jaw, Neanderthal of the mid-Paleolithic or Mousterian Period (with a restoration), and Cro-Magnon.

Story Fossils Tell. (Encyclopedia Britannica Filmstrip)

The area of concern is western North America. Depicts how fossils are removed (pieces or blocks) and shipped to a museum. Past changes of the continent are considered in chronological order. Review questions are included at the clode of thefilmstrip.

Story of the Earth We Find in the Rocks. (Our Earth Series)

Discusses what we learn from the fossils that we find. The various phases of sea life depicted from the fossil finds.

Darwin Discovers Nature's Plan. (Darwin's World of Nature Series) Life Filmstrips

The Enchanted Isles. (Darwin's World of Nature Series) Life Filmstrips

Color. Flora and fauna of the Galapagos. Pictures of the finches.

Charles Darwin. (Great Names in Biology Series) Encylopedia Britannica Films.

Silent, with captions. Color.

c. Flat Pictures

"Private Life of Primates." (Life Magazine, February 12, 1965: 48)

Part Two of a two-part series reveals the surprising facts that science has discovered about apes and monkeys and their social life. Included are the Great Apes.

"The Social Ways of Monkeys." (Life Magazine, February 19, 1965: 62-81)

Part Two of the above series reveals pictures of Old World monkeys. Included is a chart concerning the personality of primates.

"Parades of Life Through the Ages." National Geogeaphic, Vol.81, February, 1942: 141-184

Records in rocks reveal a strange procession of prehistoric life from jellyfish to dinsaurs, giant sloths, saber-toothed tigers, and primitive man. (Latter includes paintings of Neanderthal and Cro-Magnon Man).

New Discoveries Among Africa"s Chimpanzees. (National Geographic, Vol.128, December, 1965: 802-831)

Pictures and text describing the life of the chimpanzees.

CHAPTER III

FOSSIL MAN

A. Introduction

The study of fossil man is significant in several ways. First, fossil remains provide the scientific data for understanding the evolutionary development of man. Second, an understanding of the antiquity of man as a physical being provides a chronological dimension to appreciate the slow accumulation of culture, described in Chpater IV. And finally, a study of fossil man, against the broader understanding of evolution, provides new insight into the relationship of man as a physical being and man as a creature who has culture.

Frequently, students of anthropology profess a preference for cultural anthropology and ethnography and profess a dislike for physical anthropology, particularly that pertaining to fossil man. They say that the study of fossil man is a mere almanac of hard, unpronounceable names. But these names are the pegs to identify the increasing development of man toward more human like characteristics which are basic to culture. Among such characteristics are the opposable thumb, which permits the manipulation of objects with hand and eye coordination, a bipedal gait and erect posture, and the increase in the size of a functionally effective brain. Only in man are found the physical traits basic to culture. While the development of human capacities and the evolution of the organism interacted with the development of culture, the emergence of a cultural bearer necessarily preceded the emergence of culture. As Lasker has pointed out, the physical history of man is a necessary introduction to the history of man's culture.

B. Word List

*Australopithecus
*Australopithecus africanus
*Australopithecus robustus
c.c. cubic centimeter
*Cro-Magnon man
*Dryopithecus
evolution
family
genetic trait
genetic variation
genus
glaciation
*Homo erectus
*Homo erectus erectus
*Homo erectus pekinensis
*Homo habilus
*Homo sapiens
*Homo sapiens neanderthalensis
*Homo sapiens sapiens
*Homo sapiens spaelus
*Lower Paleolithic
Lower Pleistocene
*Middle Paleolithic
Middle Pleistocene
*Oreopithecus
Pliocene
*Pebble tool
*Proconsul
Radioactive isotope
species
subspecies
taxonomy
*Upper Paleolithic
*Zinjanthropus boisei

C. Objectives and Content

The objective of this section is to help children realize that there is direct and conclusive evidence of early man's existence, as shown by fossil remains and primitive stone tools, and that the development of man and his culture occurred over hundreds of thousands of years.

1. At the present time there are no known forms which directly associate any Pliocene primate genera to later Hominidae (man-like).

2. Man in a primitive form lived on earth as early as 1,750,000 years ago.

   a. The Australopithecines are the first known hominids.

   b. Pebble tools have been found with the fossil remains of Australopithecus.

   c. Australopithecus walked upright and carried his head thrust forward.

3. The species *Homo erectus* forms a bridge between Australopithecus and the first *sapiens*.

   a. Culture of *Homo erectus*:

      (1) Made and used tools

      (2) First man known to use fire

   b. Sub-species of *Homo erectus*:

      (1) Java man, found in Java

      (2) Peking man, found in China

4. *Homo sapiens*, physical and cultural characteristics:

   a. *Homo sapiens neanderthalensis*

      (1) Neanderthal man was once thought to be in Europe, a specialized form, adapted to cold weather during the third Interglacial and the beginning of the Wurm Glaciation. Neanderthal remains have subsequently been found in areas that were never covered with glaciers.

      (2) The typical Neanderthal man was a little over five feet tall, with relatively short arms and legs.

b. *Homo sapiens spaelus*

(1) *Spaelus* had a skeletal structure which was more like that of modern man than that of Neanderthal man.

(2) He appears to have existed before as well as contemporaneously with Neanderthal man.

c. *Homo sapiens sapiens*

(1) Many types of *Homo sapiens sapiens* (Modern man) lived during the prehistoric period.

(2) The process of change in the human form did not end with the arrival of *Homo sapiens sapiens*.

5. Natural actions of decomposition do not allow the soft parts of the body to endure. Therefore, we can never know what the skin, hair, or eye colorations were of earliest man.

6. While many species of men have lived on the earth in the past, only one sub-species of man now inhabits the earth--*Homo sapiens sapiens*.

D. Activities

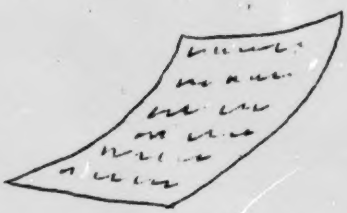
1. *Activity*: Creative Writing About the Life of a Fossil Man.

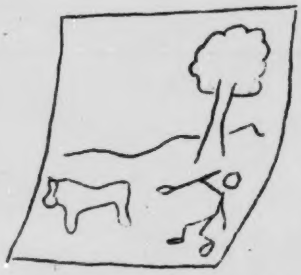
a. Purpose - To help children visualize and have a better knowledge of how man lived.

b. Materials - Penmanship paper, crayons or tempera paint, paint brushes, drawing paper, and ball point pens.

c. Procedure - Have the children write about an event in the life of the Cro-Magnon such as hunting, toolmaking, moving the camp, burial of the dead, painting in a cave, etc. Have each child make a drawing to illustrate the story.

d. Illustration -





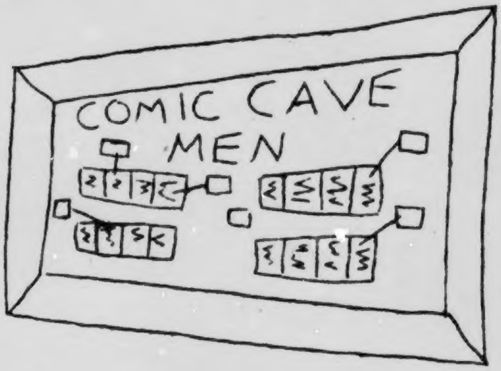
2. Activity: Comic Cavemen" Display and Criticism.

   a. Purpose - To help children review what they have learned about early man and analyze some of the misconceptions presented by comic strips.

   b. Materials - A collection of newspaper comic strips such as B.C. and Alley Oop; Bulletin board or another area in which to display the comic strips; colored paper, colored yarn, crayons, and scissors.

   c. Procedure - Ask the students to collect "cave men" comic strips (or the teacher may do it). Discuss with the class whether the events depicted could have occurred. (Example: Dinosaurs and men living at the same time could not have happened). Post each comic strip and label each correct or incorrect point found.

   d. Illustration -



3. Activity: Dramatization of an Event in the Life of an Early Man.

   a. Purpose - To help the children realize more fully how early man lived.

   b. Materials - Costumes as needed.

   c. Procedure - Help the children write a short skit depicting some event in the life of an early man and enact it.

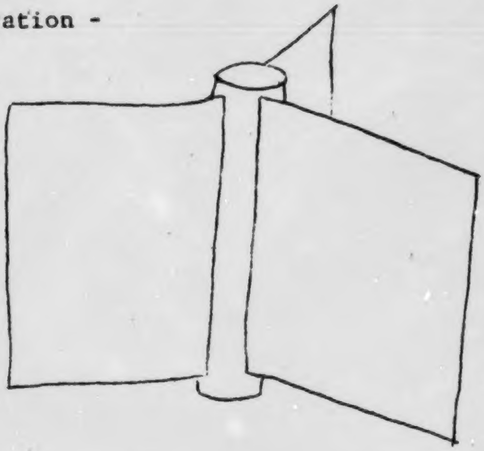
4. Activity: Mailing Tube Display of Fossil Man Newspaper Clippings.

   a. Purpose - To present some of the more recent fossil finds.

   b. Materials - A mailing tube, poster board, glue, string, newspaper clippings.

   c. Procedure - Cut 3 slots vertically in the mailing tube equally spaced around the tube. Cut 3 poster board pieces to desired size so that they will fit into the slots in tube. Arrange material on the board. Insert and glue end of poster board into slots. String linking the top edges of poster board will strengthen the device.

   d. Illustration -



Note: For another activity, see Activity 2, Old World Prehistory.

E. Review Questions

1. From Australopithecus to Cro-Magnon skull capacity increases. Modern man today, however, has a smaller skull capacity than Neanderthal and Cro-Magnon. Does this indicate they were "smarter" than Modern Man? Explain.

2. Suppose a skeleton of a previously undiscovered type is found. Why would placement of this find in a taxonomy be tentative? Explain.

3. How would you go about devising a taxonomy of man? What is the value of a taxonomy?

4. What are some of the difficulties of constructing a definitive "family tree" of man?

5. Why was primitive man able to advance himself?

F. Educational Media

1. Children's Books

Barnett, L.
1960 The Wonders of Life on Earth. New York: Golden Press.

The chapter entitled "Earth's Most Primitive People" discusses primitive mammals, their process of evolution, and their struggle for survival. Other important chapters are "The Most Primitive Primates" and "The Long Chain of Evolution."

Colbert, Edward H.
1958 Millions of Years Ago. New York: Crowell Company.

In this book the paleontologist from Columbia University takes the reader on a fossil hunt. The methods employed by the specialist in this field are well depicted.

Epstein, S.
1959 All About Prehistoric Cave Men. New York: Random House.

Discussion of Peking Man, Neanderthal Man, Cro-Magnon Man, with an interpretation of the lives they led. Reference also made to the tools, weapons, etc. that the above used.

Mansfield, James Carroll
1947 Dawn of Creation. New York: Lothrop, Lee and Sheppard Co.

Book contains chapters on the various geological ages. Of greatest importance are the chapters devoted to the study of the fossil man: Java, Neanderthal, Cro-Magnon. Also contains reproductions of cave paintings. Describes tool types, basket making, and domestication of animals.

Rhodes, F., and Shaffer.
1962 Fossils, A Guide to Prehistoric Life. New York: Golden Press.

Presents material on plant and animal life of the present and the past. Gives an introduction to invertebrate, vertebrate, and plant fossils.

Shuttlesworth, D.
1957 The Real Book About Prehistoric Life. Garden City: Doubleday.

The first chapter discusses the importance of fossils in preparing a time chart of the past. Also, discusses the methods used in collecting and preparing fossils for reconstruction. The latter part of the book is devoted to discussions of early man through the Aztecs.

2. Teachers' Books

Clarke, Grahame
1962 World Prehistory: An Outline. Cambridge; England, University Press.

Hooten, Earnest A.
1946 Up From the Apes. New York; MacMillan Company.

Howell, F. Clark
1965 Early Man. (Life Nature Library) New York; Time Inc.

Howells, William
1963 Back of History. New York; Doubleday and Co., revised edition, Natural History Library #34.

Oakley, Kenneth P.
1952 Man the Tool-Maker. London; British Museum.

Leakey, L. S. B.
1964 "Finding the World's Oldest Man." National Geographic, Vol. 118, September 1960.

1961 Exploring 1,750,000 Years Into Man's Past," National Geographic, Vol. 120, October.

Washburn, S. L.
1960 "Tools and Human Evolution," Scientific American. Vol. 203, No. 3, September.

3. Subject Area Books

Bond, A., et al.
1963 Looking Ahead with Science. Chicago; Lyons and Carnahan, pp. 64-93.

The book begins with an account of man's search for his early ancestors. In the pages listed above, reference is made to fossil finds.

Jacobson, Lauby, and Konicek
1965 Problems into Science...Grade Four. New York; American Book Co., pp. 49-98.

A discussion of what is presently known about the prehistoric era, and how this information is discovered. Included is the geological time chart and the life that can be associated with it.

4. Audio Visual Aids

a. Films

Fossils: Clues to Prehistoric Times (Coronet Films).

A description of where fossils are found and how they are formed. It describes what fossils tell us about the development of life on earth.

b. Filmstrips

Men of the Old Stone Age. (University of Pennsylvania, Educational Extension Series) Society for Visual Education. Black and white.

Begins with a chart, "Man's Place in Time," followed by a chart of the geological periods. Definitions of geology, anthropology, archeology. Discussions of Pithecanthropus erectus, Sinanthropus, and Piltdown Man (does not dispute the latter). Also included are the Heidelberg Jaw, Neanderthal of the mid-Paleolithic or Mousterian Period (with a restoration), and Cro-Magnon. If used, disregard frames concerning Piltdown.

Discovering Fossils. (Prehistoric Life Series) Encyclopedia Britannica Films. Color.

Describes how fossils are formed, beginning with the death of a plant or animal and concluding with the discovery of a fossil by a paleontologist. Review questions pertinent to the material covered are presented at the end of the filmstrip.

How We Know About Life Long Ago. (Society for Visual Education)

Describes the methods used in hunting fossils, and describes what has been found. No mammals are included.

Hunting Fossils. (Society for Visual Education)

Describes how fossils are formed, where they can be found, how to identify them, and the general technique of interpretation. Shows the excavation of a skull, and the techniques used in restoring dinosaur remains.

Story Fossils Tell. (Prehistoric Life, No. 2) Encyclopedia Britannica Films. Color.

The area of concern is western North America. Depicts how fossils are removed (pieces or blocks) and shipped to a museum. Past changes of the continent are considered in chronological order. Review questions are included at the close of the filmstrip.

Story of the Earth We Find in the Rocks. (Our Earth Series)

Discusses what we learn from the fossil finds.

The Nature of Fossils. (Earth Science Series)

Excellent filmstrip on fossil and fossilization. 51 fr. Ward's. Appropriate in connection with Fossil Man material.

The Story of Fossils.-(Popular Science Filmstrip) 40 fr. McGraw-Hill New York, Text-Film Dept., 1958. Color.

Man Inherits the Earth. (Epic of Man, Part IA) 79 fr. Color. Some of the assumptions are questionable, but pictures are excellent.

Flat Pictures

Big Game Hunting in the Land of Long Ago. (National Geographic, Vol. 91: 277). Photographs of prehistoric fossils of animals which are now extinct.

Slides

Prehistoric Art. (Cultural Historical Research, Inc.)

Contents: slides depicting early man sites, with cave-art. Good, but may be difficult to procure.

Art Treasures of Prehistoris Man. (Cultural History Research, Inc.)

A pilgrimage to the decorated caves of prehistoric man. Includes slides of prehistoric man's footprints, fireplaces, where he cooked, and his tools.

CHAPTER IV

OLD WORLD PREHISTORY

A. Introduction

It is common for historians to relate the story of man from the beginning of written records, a time some five thousand years ago which is also used to mark the beginnings of western civilization.

The recorded history of man is but a minute in the slow development of his culture. Man lived for hundreds of thousands of years before he left written records, and thus for most of his time on earth man has no "history." But prehistoric man left far more than his fossil remains, described in the preceding chapter, as evidence of his existence and of his culture. Tools, utensils, weapons, drawings, paintings, remains of dwellings, and other bits of evidence reveal to the archeologist some knowledge of the nature of early cultures.

The story of man's history, presented in this chapter, begins in the twilight of the Late Pliocene or Early Pleistocene and ends with the Urban Revolution and diffusion of modern technologies. For the longest part of this time, the cultural advance of man was exceedingly slow, and it was not until the Mesolithic, beginning some 10,000 years ago, that there is a substantial increase in man's tool inventory and techniques. After this period, cultural developments become more rapid--the Neolithic is followed soon by the Bronze Age and the Bronze Age rapidly gives way to the Iron Age. In a space of a few thousand years man experiences a dizzying cultural advance--from a stage of hunting and fishing to food production to urbanization.

Today we are indeed proud of our new technological accomplishments in space. Awe inspiring though these may be, they pale in significance to such great early inventions of man as the use of fire, the wheel, and the domestication of plants and animals. The discovery of how to produce food is man's most revolutionary achievement. And the ability to produce food in a surplus, so that the labor force is freed from the struggle of mere subsistence, is basic to the development of technological societies.

Old World Prehistory is divided into a number of culture periods. The date of these periods is approximate, not only because of the uncertainty in dating, but because the various cultures of prehistory, considered geographically, developed unevenly. There is no sharp demarcation between the Paleolithic and the Neolithic or between the various periods of these cultures. Furthermore, cultural diffusion has not been uniform, and there are areas in the world today in which the culture, in comparison to western technology, remains "primitive."

In the development of man's culture, almost all sections of the Old World at some time made some important contribution to the culture of man. Western Europe, where the early fossil and archeological finds were found, had no monopoly on the development of culture. Africa as well as Asia was at times significant location for the development of man and culture.

B. Word List

*archeologist
*Bronze Age
*burin
*chopper tool
*civilization
*core tool
*domestication
*flake tools
*hand-axe
*Industrial Revolution
*market economy
*Mesolithic (Middle Stone Age)
*microliths
*Neolithic (New Stone Age)
*Paleolithic (Old Stone Age)
Pluvials
*pressure flaking
*specialized stone tools
*tradition
Upper Pleistocene
*Urban Revolution

C. Objectives and Content

The primary objective of this section is to help children understand the long duration of prehistoric times, the gradual development of the cultural base, and the acceleration of cultural change resulting from food production and urbanization.

1. The development of man is unique because of the emergence of his capacity for culture.
    a. Culture is the way of life of a group of people.
    b. Man alone has culture as a means of adjusting to his environment.
    c. Culture development took place over an immense span of time.
2. Primitive men are known mainly by tool making traditions and means of subsistence.
    a. In the Paleolithic (Old Stone Age) about 1,750,000 to 15,000 years ago, man used several different stone tools in hunting and gathering.
        (1) Lower Paleolithic man used core and flake tools, including pebble tools, hand axes, and chopper tools.
        (2) Middle Paleolithic man used tools only slightly advanced over Lower Paleolithic flake tools.
        (3) Upper Paleolithic man mass produced long blades and refined them by pressure flaking. From the basic blade he made a variety of tools:

        (a) concave scrapers
        (b) convex scrapers
        (c) awls
        (d) burins

    (4) During the Upper Paleolithic horn and bone tools were introduced, including the needle.

b. During the Mesolithic (Middle Stone Age) about 15,000 to 7,000 years ago man's tool kit was greatly increased.

    (1) Instead of a whole blade, small sharp pieces of blades, called microliths (small stones), were set in the handle or shaft of a weapon.

    (2) A true axe mounted on a handle was developed.

    (3) The bow and arrow came into general use.

    (4) Boats were developed.

    (5) Invention of the true fish hook made line fishing possible.

    (6) Mesolithic hunting and gathering people learned to use all available animal and plant food.

c. The Neolithic (New Stone Age) began about 7,000 B.C. Food production replaced hunting and gathering.

    (1) The change to food production during this period is considered the key step in man's cultural development.

    (2) Although this period is called the "Neolithic revolution," the change took place gradually.

    (3) During this stage of development village life began. The production of food through domesticated plants and animals made it possible for man to live together in larger groups.

    (4) Polished stone tools were introduced during this period.

d. In the Bronze Age, bronze tools were used, trade was increased, and urban society began.

    (1) The growth of literate urban societies from Neolithic villages was a result of many changes that took place over several thousand years. The most important of these were:

(a) Increase in agricultural production.
(b) Specialization.
(c) Growth of central authority.
(d) Trade.

(2) The widespread use of metal tools illustrates that the changes in living patterns were directly related to the growth in technology.

e. The Bronze Age ended around 1400 B.C. when iron working began.

(1) The development of the Iron Age brought about thriving kingdoms based on agriculture, use of animal power, and iron technology.

(2) Iron Age technology was not generally surpassed until the beginning of the Industrial Revolution a little over 200 years ago.

(3) The rate of cultural change has not been uniform. In many areas of the earth today, agricultural villages resemble the Neolithic. In isolated areas, there are also men whose culture resembles the Mesolithic.

(4) Cultural advance accelerated as the amount and the reliability of the food supply improved.

(a) Hunting and gathering for food involved many uncertainties. Better weapons and cooperation with other men increased the hunter and gatherer's chance of success.

(b) The change to food production provided a much more reliable source of subsistence.

(5) Different areas of the world have made contributions to the development of culture.

(a) The first tools were developed in Africa.

(b) Food production was probably first developed in the Eastern Mediterranean area.

(c) The Industrial Revolution began in Western Europe.

D. Activities - (Some activities which can be utilized to accomplish the objectives for this segment of Old World Prehistory follow. The teacher can select those most appropriate for his own classroom.)

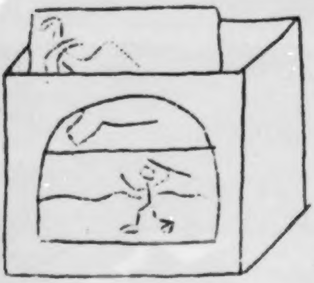
1. Activity: Construction of a Slide Viewer

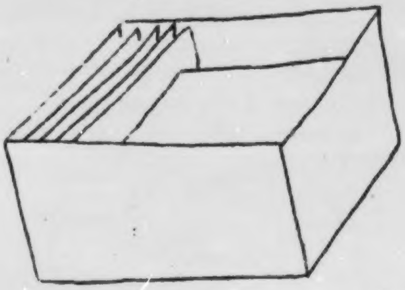
   a. Purpose - To present pictorially material on prehistoric man in the Old World.

   b. Materials - Cardboard box, paint, brushes, crayons, poster paper, scissors and tape.

   c. Procedure - Cut an opening in the front of the box. Then cut necessary number of cards to fit inside the box opening. Make illustrations freehand or with the use of the opaque projector of tool types and activities of the different ages. Arrange these in sequence from front to back. The first card is the title. Place a smaller box inside, behind the cards to keep them in an upright position. The cards are removed as needed for illustrations.

   d. Illustration -





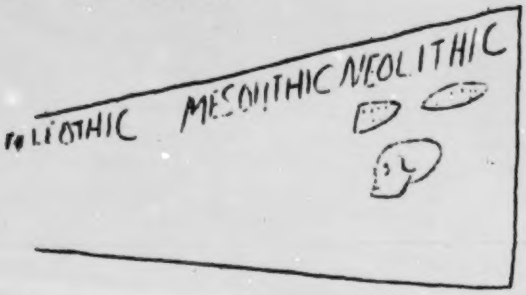
2. Activity: Time Chart (Presented as a bulletin board or frieze).

   a. Purpose - To depict the progression of tools used in the Lower, Middle, and Upper Paleolithic, Mesolithic, and Neolithic Eras.

   b. Materials - A large piece of paper as long as desired, magic markers, colored pencils, or India ink, and smaller pieces of paper.

   c. Procedure - On the large piece of paper, mark off according to scale the Paleolithic, Mesolithic, and Neolithic Eras. Place drawings of the tools either made freehand or with the opaque projector along the time line in sequence. Room may be left so that the drawings of skulls of men found may be added when the unit on fossil man is studied.

d. Illustration -


PALEOLITHIC
MESOLITHIC
NEOLITHIC

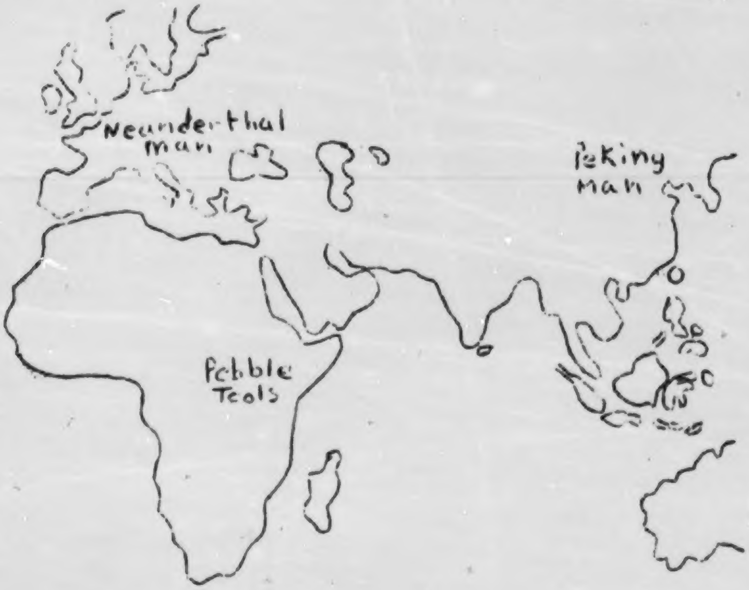
3. Activity: Map Activity

   a. Purpose - To map pictorially the origin and distribution of the different tool traditions.

   b. Materials - A large piece of paper, a map of the Old World (small for opaque projector for direct tracing or large one for visual purposes), magic marker or colored pencils, and pins or thumb tacks.

   c. Procedure - Trace on the large piece of paper an outline map of the world. Sketch and cut out representations of the various tools, and labels for them. Pin or thumb tack the tools onto the area of the world in which they were used. Sketches of the different fossil skulls may also be added in conjunction with the study of this topic.

   d. Illustration -


Neanderthal man
Peking man
Pebble Tools

4. **Activity:** The Story of Man fold out.

   a. Purpose - To present the story of man in the Old World by cultural epoch.

   b. Materials - Box, art paper, felt pen, tape, etc.

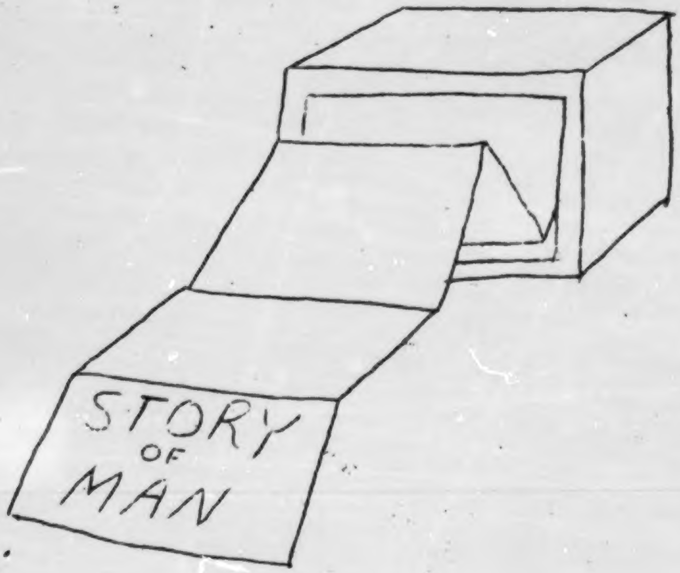
   c. Procedure - This technique is basically to make an accordion fold containing the points and illustrations to be used in the presentation.

      (1) Cut a side out of the box. This piece should then be hinged to the box so that it opens to hang down.

      (2) Cut the necessary cards and fit together with masking tape.

      (3) Attach the last card in the sequence to the inside back of the box.

   d. Illustration -



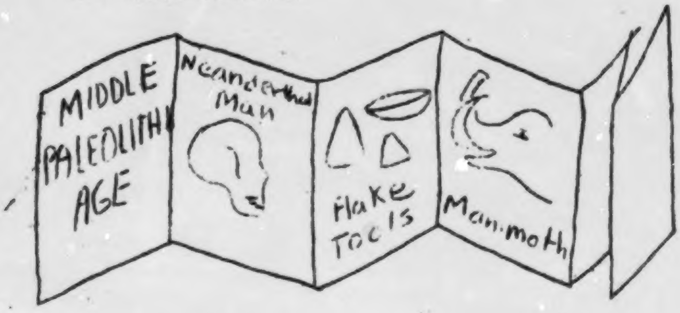
5. Activity: The Cultural Epoch Standing Accordion Fold.

   a. Purpose - To depict and identify characteristics of a particular cultural period.

   b. Materials - Art paper, felt pen, tape, crayons, etc.

   c. Procedure - Plan the number of illustrations using poster board; cut the desired number necessary. All cards the same size, such as 18 x 24; hinge the cards together using masking tape. Arrange illustrations and descriptive matter in proper sequence.

   d. Illustration -



6. Activity: Making a Stylus and a Reed Brush

   a. Purpose - To see what ancient artists used for writing and painting.

   b. Materials - Stick or reed.

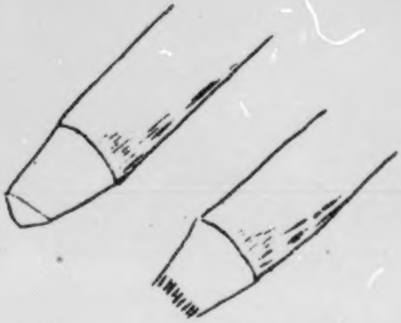
   c. Procedure -

      (1) Sharpen the stick or reed to make a stylus for writing in clay.

      (2) Stick about 6 inches long as shown in the illustration.

      (3) To make a paint brush from a stick, you will need a different kind of point. A rather blunt end is needed to get the proper effect. Children can actually write in clay and/or do art work with sticks or reeds with blunted ends.

d. Illustration -



E. Review Questions

1. What is the difference between a tradition and a culture? Give an example of each.

2. What was the original basis of the terms Paleolithic, Mesolithic and Neolithic? What other aspects have been added?

3. It has often been said that the amount of knowledge increase from 1900-1950 doubled all previous knowledge and from 1950-1960 doubled again. Explain this acceleration on the basis of what you have learned in this unit.

4. Why are the changes of the Neolithic and Urban times called "revolutions," while changes in Lower, Middle, and Upper Paleolithic and Mesolithic times are not?

5. Some authorities believe we are at present in an interglacial period. If another ice age occurs, the present cultures of the world will undergo changes. How may adaption to environmental changes be expected to vary from those experienced by Neanderthal Man? Explain.

F. Educational Media

1. Children's Books

Barnett, L.
1960 The Wonders of Life on Earth. New York, Golden Press.

The chapter entitled "Earth's Most Primitive People," discusses primitive mammals, their process of evolution, and their struggle for survival. Other important chapters are "The Most Primitive Primates," and "The Long Chain of Evolution."

Clark, M.
You and How the World Began. New York: Children's Press.

Traces the development of life from the simplest marine life to early man. Large reproductions of Java Man, Neanderthal Man, and Cro-Magnon Man are included.

Daugherty, C.
1962 The Great Archeologist. New York: Thomas Crowell Co.

Only parts of this book are relevant to the unit, specifically, the archeological finds made by noted archeologists. A distinction is drawn between the amateur and the professional archeologists.

Edel, M.
1955 The Story of Our Ancestors. Boston: Little, Brown, and Co.

Discussion of the fossil record of the past one million years, our early ancestors.

Epstein, S.
1959 All About Prehistoric Cave Man. New York: Random House.

Discussion of Peking Man, Neanderthal Man, Cro-Magnon Man, with an interpretation of the lives they led. Reference also made to the tools, weapons, etc. that the above used.

Halden, R.
1960 Secrets in the Dust. New York: Dodd, Mead, and Co.

This is the story of archeology. Discusses cave paintings, Egyptian tombs, the last civilizations of Central America, the accidental unearthing of prehistoric tools in the American Southwest, and the "City of Ivory Eyes" in Alaska.

Hibben, F.
1960 Digging Up America. New York: Hill and Wang.

This book discusses dating techniques, entrance of the Indians to the New World. Examines the Mound Builders of the Mississippi Valley, the Pueblos of the Southwest (with chronology), and the Incas.

Knight, C.
1946 Life Through the Ages. New York: A. A. Knopf.

The story of early man and animals he hunted. Discussion of the techniques and tools used in the pursuit of game.

McGuire, E.
1950 Glimpses Into the Long Ago. New York: Macmillan Co.

Story about life in the Old Stone Age, the first people, where they lived. Discusses the New Stone Age. One section devoted to the making of pottery and weaving.

Mansfield, C.
1947 Dawn of Creation. New York: Lothrop, Lee and Sheppard Co.

Book contains chapters on the various geological ages. Of greatest importance are the chapters devoted to the study of the fossil men: Java, Neanderthal, Cro-Magnon. Also contains reproductions of cave paintings. Describes tool types, basket making, and domestication of animals.

Mellersh, H.
1962 Finding Out About Ancient Egypt. New York: Lothrop, Lee and Sheppard Co.

Describes what ancient Egypt was like four thousand years ago. The customs, religion, and routine daily life are discussed.

Peattie, D.
1937 A Child's Story of the World. New York: Simon and Schuster.

Only the first part of the book is pertinent to the unit. There is a discussion of the Old and New Stone Ages and the art of prehistoric man, followed by description of early Egyptian life.

Scheele, Wm.
1957 Prehistoric Man and the Primates. Cleveland: The World Publishing Co.

The story of the beginning of man and the paths that his evolution is thought to have followed. Glossary included.

Shuttlesworth, D.
1957 The Real Book About Prehistoric Life. Garden City: Doubleday.

The first chapter discusses the importance of fossils in preparing a time chart of the past. Also, discusses the methods used in collecting and preparing fossils for reconstruction. The latter part of the book is devoted to discussions of early man through the Aztecs.

Winer, B.
1961 Life in the Ancient World. New York; Random House.

Discusses Mesopotamia, Egypt, between 3000 B.C. to the time of Christ.

2. Teacher's Books

Braidwood, Robert J.
1957 Prehistoric Man, 3rd ed. Chicago: Chicago Natural History Museum, Popular Series.

Braidwood, Robert J.
1952 The Near East and the Foundations for Civilization. Eugene: Oregon State System of Higher Education.

Childe, V. Gordon
1963 Man Makes Himself. New York: Mentor Books.

Childe, V. Gordon
1961 What Happened in History. Baltimore; Penguin Books, Inc.

Coon, Carleton S.
1962 The Story of Man. New York: Alfred A. Knopf.

Frankfort, Henri
1956 The Birth of Civilization in the Near East. New York: Doubleday Anchor Books.

Hawkes, Jacquetta
1965 Prehistory. New York: Mentor Books.

Hogarth, Paul and Jean-Jacques Salomon
1962 Prehistory: Civilizations Before Writing. New York; Dell Publishing Co.

Howell, F. Clark
1965 Early Man. New York: Time Inc., Life Nature Library.

Howells, William W.
1963 Back of History. New York; Doubleday and Co.

Oakley, Kenneth P.
1964 Man, The Tool-Maker. Chicago; The University of Chicago Press, Phoenix Books.

Woolley, Sir Leonard
1965 The Beginnings of Civilization. New York: Mentor Books.

3. Subject Area Books

Bond, G. et. al.
1954 How Different People Kept Their Record. Chicago: Lyons and Carnahan, pp. 189-196.

Refers to the methods used by ancient peoples to record those events which seemed important to them. Mentions the paintings of cave man and the writings of the Egyptians and Phoenicians.

Ahlschwede, Ben
1963 Exploring the Old World. New York: Follett, pp. 18-29.

Selection on primitive man and the contributions that archeology has made to our knowledge of him.

Fraser, D. and A. Magenis
1964 Discovering Our World's History. New York: American Book Co., pp. 4-64.

Section concerned with the study of prehistoric people and the development of civilizations. This unit provides examples of the various sources of information: physical remains, graphic record, legends, the Bible.

Fraser-Hoy
1961 The Dawn of Man's History. New York: American Book Co., pp. 26-37.

How early man lived and the development of civilizations.

Gatis, A. and Celeste Peardon
1958 A World to Enjoy. New York: Macmillan Co., p. 244.

This selection contains stories about man's first permanent homes, the Egyptian religion, and the measuring of time. Also included is a detailed description of the discovery of Mycenae.

4. Audio Visual Aids

a. Films

Cave Dwellers of the Old Stone Age. (Encyclopedia Britannica Films).

A visit to a museum becomes a journey of exploration into the past. Includes an exhibit of dwellings and a reconstruction of the daily life of Neanderthal and Cro-Magnon Man. This story is recreated from an assortment of clues: skeletons, artifacts, and cave paintings. Produced in southwestern France where a Cro-Magnon cave was discovered.

Prehistoric Man in Northwestern Europe. (Encyclopedia Britannica Films). Black and white, 14 min., sound.

The story of man from the beginning of the New Stone Age.

Signs and Symbols. (University of Southern California).

This film describes the means of communication used by primitive man prior to the development of an oral language. These means include marks, signals, pictographs and sign language. Illustrates cave paintings, and demonstrates the use of sign language.

Ancient Egypt. (Coronet). Color or black and white, sound.

A visit to ancient Egypt to see the Great Sphinx, the Temple at Karnak, and other examples of Egyptian architecture. Traces the development of agriculture and community living.

Forty Centuries. (Pictura Films Distribution Co.)

Man's search for his own past through archeology is the theme of this film. Stresses the excavations of the tombs of Egyptian Pharaohs.

Egypt: Cradle of Civilization. (Encyclopedia Britannica Films). Color or black and white, 12 min., sound.

Surveys the culture of ancient Egypt and examines its contributions to the development of Western civilization. Shows how a way of life evolved from a primitive tribal culture to an organized society under a single ruler.

Ancient Egyptian. Julian Bryan - International Film Fdtn.

The paintings, sculpture, and architecture of the ancient Egyptians are used to reveal his true character but the focus is always on the man himself-- his temperament, achievements, and religion.

Ancient World Inheritance. (Coronet). Color, 16 min., sound.

The relation of the achievement of ancient civilizations to institutions of the modern world.

b. Filmstrips

Men of the Old Stone Age. SVE (University Museum Series).

Begins with a chart, "Man's Place in Time," followed by a chart of the geological periods. Definitions of geology, anthropology, and archeology. Discussion of *Pithecanthropus erectus*, *Sinanthropus*, and Piltdown Man (does not disput the latter). Also included are the Heidelberg Jaw, Neanderthal of the mid-Paleolithic or Mousterian Period (with a restoration), and Cro-Magnon. Black and white

The Joint Expedition of Ur of the Chaldees. (Society for Visual Education). Black and white.

Presents map of Mesopotamia and pictures of the excavation of the Ziggurat (between the 3rd and 2nd millennium B.C.), the Hall of Justice, and the Royal Tombs.

Prehistoric Art. (Cultural History Research, Inc.) Slides.

Contents: slides depicting early man sites, with cave-art. Good, but may be difficult to procure.

Prehistoric Man--Dawn of Civilization. (Eye Gate House, Inc., Old World Backgrounds of American History). Color.

Discusses contributions of early man. Included are fire, tools, weapons; work in wood, clay, stone; first carts and boats, first artists; beginning of religion; first communities.

Man of Long Ago. (Curriculum Films, Inc., 1951) Color.

Traces of ancient man give scientists clues to early man's way of life, his adaptation to his environment, and the steps in his development toward civilization.

Primitive Tools. (University Museum Series) Society for Visual Education. Black and white. Not in production.

An old filmstrip that is very accurate. Eoliths are not described in unit material.

Dawn of Religion. (Epic of Man, Part II A) Life Filmstrips. Color.

From frame 44 good for showing how cave paintings were done.

The Growth of Society. (Epic of Man, Part III A) 59 fr. Life Filmstrips. Color.

Deals with Mesolithic in northern Europe.

The Discovery of Agriculture. (Epic of Man, Part IV A) 54 fr. Life Filmstrips. Color.

Contains inaccuracies and some doubtful assumptions, but the pictures are very good.

Neolithic Folk Today. (Epic of Man, Part IV B) 64 fr. Life Filmstrips. Color.

Deals with the Berbers. A little overgeneralized as far as being typically Neolithic.

Coming of Civilization. (Epic of Man, Part V A) 74 fr. Color.

Sumer, The First Great Civilization. (Epic of Man, Part V B) 59 fr. Life Filmstrips. Color.

One or two questionable inferences, but generally good presentation of organization of an early city state. Also shows change from Neolithic to civilization.

c. Flat pictures

"Parade of Life Through the Ages." (National Geographic, Vol. 81, February, 1942: 141-184)

Records in rocks reveal a strange procession of prehistoric life from jellyfish to dinosaurs, giant sloths, saber-toothed tigers, and primitive man (latter includes paintings of Neanderthal and Cro-Magnon Man).

d. Slides

Art Treasures of Prehistoric Man. (Cultural History Research, Inc.

A pilgrimage to the decorated caves of prehistoric man. Includes slides of prehistoric man's footprints, fireplaces, where he cooked, and his tools.

The Story of Ancient Man. (American Museum of Natural History).

This set of color slides presents the fossil men known today by their skeletal remains. Included are the implements, tools, weapons, that each race used as well as examples of their artistic achievements.

VOCABULARY (GLOSSARY)

*absolute dating	- method for dating an object found in an archeological excavation which gives a more or less fixed date.
*adaptation	- Adjustment of an organism to its environment; adaptation is the directing force of evolution.
*archeologist	- scientist who studies the material remains of past human life and activities.
*archeology	- branch of anthropology that is concerned with the historical reconstruction of cultures no longer extant.
*artifacts	- anything produced by human effort.
*Australopithecus	- Lower Pleistocene hominids genus, of which there are several forms.
*Australopithecus africanus	- first species the genus Australopithecus to be found. Analysis of finds indicate that he stood 5 feet tall and weighed about 50 to 60 pounds. A cranial capacity of from 450-750 cc is indicated.
*Australopithecus robustus	- larger species of the genus Australopithecus.
*Bronze Age	- period of human culture characterized by the use of bronze tools beginning in Europe about 3500 B.C. and in western Asia and Egypt somewhat later.
*burin	- flake chisel for sculpturing and engraving which made it possible for Upper Paleolithic man to make extensive use of horn, bone, and wood.
*calendrical dating	- absolute dating system involving a calendar system and the use of dated coins, dated building cornerstones, or articles known to have been used for only a short time.
*carbon 14 dating	- absolute dating technique based on the amount of disintegration of carbon 14, a radioactive isotope, over a period of time.
ceremony	- rite or formality; a formal procedure.

*Anthropological terms and definitions

*chipping station	- area in which prehistoric man manufactured stone tools.
chromosomes	- one of the tiny rod-like filaments found in the nucleus of a cell. Any one kind of plant or animal usually has a constant number in its cells; in man this number is 23.
*civilization	- stage of cultural development in which writing, written records, urbanization, advanced arts, science, political life, expanded population, and complex social organization are present.
*Cro-Magnon Man	- prehistoric form of the sub-species _Homo_ _sapiens_ _sapiens_. He was fairly tall, his skull, and his facial features clearly within the range of those of modern Europeans.
cross	- mating of two individuals who differ in certain traits.
c.c., cubic centimeter	- a body with six equal square faces or sides each measuring one centimeter in length and width.
*cultural traits	- smallest individual unit of culture. Those traits which can be touched are _material traits_. Beliefs, attitudes, laws, etc. are _non-material traits_.
*culture	- way of life of a group of people. All of the capabilities and habits acquired by man as a member of society are included in his culture.
*dendrochronology	- method of archeological dating based on the variation in size of a tree's annual rings.
dehydration	- abnormal depletion of fluids resulting from deprivation or loss.
*Dryopithecus	- fossil form of an early ape that lived during the beginning of the Pliocene.
ecology	- branch of biology studying the interaction between the organism and its environment.
evolution	- change through time.
excavation	- digging or clearing away soil and debris; also, a hollow formed in the earth by digging.

family	- social institution consisting of one or more women living with one or more men and their children.
fossils	- remains or traces of plants or animals which lived in prior periods and are preserved with chemical changes.
gene	- one of the elements of the germ plasm serving as specific transmitters of hereditary characteristics.
*gene pool	- the total group of genes which may continue generation after generation.
*genetic drift	- change resulting from the accidental loss of certain genes from the gene pool.
genetic trait	- biological characteristic transmitted by genes.
genetic variation	- biological change which is due to a change in the gene structure.
*generalized animal	- animal which has developed few specialized parts and is able to live in various environments.
*genotype	- actual group of genes carried by an individual. (genetic type)
genus	- a class, kind, or group marked by common characteristics or by one common characteristic; a taxonomy between family and species.
glaciation	- condition of being covered by ice sheets or glaciers.
geology	- science which deals with the structure of the earth.
habitation	- a dwelling place.
herdity	- tendency of any living thing to reproduce the characteristics of its ancestors.
Holocene Epoch	- scientific name for the period of time when the world became as it is today. The Holocene Epoch began about 10,000 years ago with the ending of the fourth glaciation.

*Homo erectus	- remains of this species date from the Middle Pleistocene. He walked upright and made and used tools.
*Homo erectus erectus	- commonly called Java Man. Fossil remains of this sub-species were first found in 1891. He had a short face with enormous brow ridges, a low forehead and a brain case of about 900 cc. He stood about 5 feet 8 inches tall, and lived during the Middle Pleistocene.
*Homo erectus pekinensis	- commonly called Peking Man. Fossil remains of this sub-species are similar to Java Man with certain more advanced characteristics, such as a larger cranial capacity (1300 cc) and a more developed forehead. He lived during the Middle Pleistocene.
*Homo habilis	- a Australopithecine from the Upper Pleistocene. He had a cranial capacity of 682 cc and stood about 4 feet tall.
*Homo sapiens	- genus and species of man which emerged in the Upper Pleistocene.
*Homo sapiens neanderthalensis	- a sub-species of man that lived during the Upper Pleistocene. He was short with a large skull and heavy brow ridges. The skull had a cranial capacity of about 1300 to 1800 cc with a less well developed forebrain than that of modern man.
*Homo sapiens sapiens	- Modern man.
*Homo sapiens spaelus	- a sub-species of man that includes several types that were once considered as "progressive" Neanderthals. He appears to have lived before as well as contemporaneously with Neanderthal. Although these forms resemble Neanderthal in certain ways, they have more traits that approximate those of later sapiens.
*Industrial Revolution	- term used to refer to the complex of changes from inventions, use of steam for power, and extensive use of iron for machinery, that ushered in moder industrialism.
*innovation	- new way of doing things.
*isolation	- state of being set apart from others.
*Lower Paleolithic	- early part of the old stone age.

Lower Pleistocene	- subdivision of the Pleistocene beginning somewhere between one and two million years ago and lasting to the end of the second glaciation about 480,000 B.P.
Malthusian principle	- human population increases at a faster rate than food production and certain checks necessarily limit the human population.
Market economy	- production of goods to sell rather than production for needs.
Mesolithic	- the period of man's prehistory between the Paleolithic and Neolithic Ages. During this time, man developed advanced hunting methods and used a form of blade.
*Middle Paleolithic	- the middle part of the old stone age.
Middle Pleistocene	- the subdivision of the Pleistocene beginning about 480,000 years ago with the beginning of the second interglacial and ending about 190,000 years ago with the end of the third glaciation.
*migration	- the movement of individuals into and out of a population.
mutation	- change in the chemical structure of a gene. The different or "new" gene results in a new trait in the individual carrying the mutated gene. Mutations may be considered mistakes or errors in the duplication of chromosomes.
natural selection	- since each species reproduces more individuals than can live to reproduce, some must die before reproducing. The organisms that survive and leave offspring are those best adapted to their environment. Also, the organisms that are not as well adapted to their environment are less likely to produce descendents.
*Neolithic	- "Neo" means new; "Lithic" means made of stone. The period of man's prehistory when he learned to domesticate animals and plants and used polished stone tools.
*Oreopithecus	- an early fossil form that is considered by many to be a member of the hominid line. He lived during the Pliocene period.

organic evolution	- the development of a plant or animal, in the course of time, by a sequence of changes resulting from the adjustment of the organism to its environment. All living organisms evolved from common forms in a gradual historical process of change and diversification.
*Paleolithic	- the earliest and longest period of man's prehistory when he made chipped stone tools. Commonly called the Old Stone Age.
paleontology	- the study of prehistoric life through fossil evidence.
*Pebble tool	- a crude tool made by chipping one or more flakes off one end of a water washed stone.
periphery	- the circumference of any curved figure, plane or solid.
*phenotype	- all of the traits which may be observed in an individual (visible type).
placentals	- a mammal in which the female has a placenta.
Pleistocene Epoch	- the scientific name for the period beginning somewhere between one and two million years ago and lasting until 10,000 years ago. This epoch is commonly called the Ice Age because during the Pleistocene, the northern part of American and Europe was covered by large sheets of ice at least four times.
*population	- a particular group of closely related individuals living in a particular area.
Pluvials	- the periods of excessive rain which occurred in regions that are now drier during the periods of glaciation.
*potassium-argon dating	- this method of archeological dating can be applied to old rock deposits which contain potassium. Over millions of years potassium decays into argon at a regular rate. By measuring the amount of potassium and argon present, the age of the rock can be determined.
preservation	- the act of keeping or state of being kept from injury or decay.
*pressure flaking	- a flint working technique that involves the use of a blunt tool to press off small flint chips where needed.

Principle of Superposition	- the bottom layers of rock are the oldest, that is, they were deposited earlier than the rocks covering them.
*primitive	- formerly used to designate native or aboriginal groups. Since the term connotes backwardness or inability to accept western culture, it is seldom used by anthropologists today. Now the term preliterate is used to describe these societies.
*Proconsul	- a fossil form dating from the Miocene that appears to have been ancestral to the modern apes and possibly man.
quadrant	- the fourth part of a circle, contained within an angle of 90 degrees.
radioactive	- emitting rays of energy or rays of electrified particles.
*relative dating	- a method for dating an object found in an archeological excavation which does not give a fixed date but rather tells if the object is older, of the same age, or younger than another.
*salvage archeology	- archeology which is designed to save a site from destruction, usually from some man-made endeavor such as a dam or pipe line.
*seriation	- arranging artifacts in some sequence by type to determine age; a method of relative dating.
*site	- in archeology, a place used by man; also, the place of an excavation or a place of archeological importance.
*specialized animal	- an animal that has developed traits and body parts enabling it to be very efficient in a specific environment.
*specialized stone tools	- stone tools made for a specific purpose as opposed to an all-purpose or generalized tool.
species	- a group of plants or animals smaller than a genus belonging to that genus but differing in some details.
strata	- beds of earth or rock constituting a layer.

*stratigraphy	- in archeology, the picture of the changing culture content of an archeological site, as reflected in the content of its strata; in geology, relating to the strata of sedimentary rock.
*surface collection	- artifacts which are obtained from the top of the earth at an archeological site.
*test pits	- pits which are dug at an archeological site to obtain information as to the content of the site as a guide to further excavation.
*test trenches	- trenches which are dug at an archeological site to obtain information as to the content of the site as a guide to further excavation.
Theory of Uniformatarianism	- The forces now in operation on the earth are the same forces that had always operated on the earth; large changes, such as the uplifting of mountain masses, took place over long periods of time.
*tradition	- customs and beliefs of a people transmitted from one generation to another.
*Upper Paleolithic	- the most recent part of the Old Stone Age.
Upper Pleistocene	- the subdivision of the Pleistocene beginning about 190,000 years ago with the beginning of the third interglacial and ending about 10,000 years ago with the end of the fourth glaciation.
Urban Revolution	- the process by which cities developed.
variation	- the principle that the individuals of a species differ in some ways.
vertebrate	- an animal having a spinal column.
*Zinjanthropus boisei	- a fossil hominid that has been dated at about 1,750,000 years. He was an Australopithecus.

The Development of Man and His Culture: Old World Prehistory

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ARCHEOLOGICAL METHODS

Anthropology and Archeology

Anthropology is the study of man and his culture. The scientists who study man are called anthropologists.

Archeology is a branch of anthropology. Archeology is the study of how man lived long ago. Scientists who study how man lived long ago are called archeologists. An anthropologist who studies how man lived long ago is an archeologist.

History and prehistory. Today we know much about man's past. Some of the past we know about from written records. The study of our past from written records is history. A scholar who uses written records to write about man's past is called an historian.

Writing is a new invention. Man lived over a million years ago. Picture writing was invented 5,000 years ago. The alphabet was invented 4,000 years ago. How do we know about man's past before writing? The time when men had no writing is called prehistory. Prehistory means the long, long time before writing. How do we learn about man in prehistory?

Paleontology is the science of extinct life based on fossil remains. It is the study of old things. It is a science shared by biology and geology. Biology is the study of plant and animal life; geology is the study of the origin and nature of the earth's crust. Physical anthropology which deals with fossil man is a division of paleontology as well as of anthropology. Fossil remains are the remains of organic materials which have been mineralized.

We know about man in prehistory from paleontology, physical anthropology, and archeology. We learn most about his culture from the artifacts he left behind. Archeologists primarily study about how man lived long ago from the artifacts he left behind.

The Record from Artifacts

Man has always made things. This is one way in which man differs from other animals. Things made by man are called artifacts. Man has made weapons to kill animals. He has made tools to use in building. He has built houses. He builds factories and rockets. All of these things--a spear point and a satellite--are artifacts.

Artifacts get left behind: stone axes, broken vases, a child's doll, the walls of great cities. Man dies, but he leaves behind many things. We know about man's prehistory--before written records--from the artifacts he left behind.

Organic and inorganic artifacts. Artifacts can tell us only a part of man's prehistory. Artifacts are made from many different kinds of materials. Some of these last for a very long time while others do not.

Organic materials do not last a long time. Artifacts made from organic materials are made from plants and animals. These rot and decay, especially in wet climates, but many do not last even in dry climates. Wooden house posts and leather sandals are organic artifacts.

Inorganic materials last a long time. Some inorganic materials are stone, metal, and clay. Artifacts made from stone, such as a spear point, last many thousands of years.

Artifacts tell us only a part of prehistory because most of the artifacts found are of inorganic material. The artifact record of early man is not complete.

Man's Culture is More Than Artifacts. Artifacts can tell us only a part of man's prehistory because man's culture is made up of more than artifacts. Man talks, sings, tells stories, plays games, and works. Man marries, raises families, worships, educates his children. He wears certain kinds of clothes. He builds homes. He eats and sleeps. All the ways of living make up man's culture.

An archeologist can only try to understand what he finds. A spear point and hunting knife found with a skeleton may tell us the man was a hunter. But it does not tell us how he talked, how he sang, how he loved his wife, or how he raised his children.

The archeological record of prehistory is incomplete. There are many clues, but there are parts of the story which are missing.

Archeology and History

Archeology also helps us to understand history. History is a description; the words tell us about the past. Artifacts are things; things also tell us about the past. If we can put things and words about the past together, we can learn more about it. Archeology, therefore, helps us to understand history.

This example shows how archeology helps us to know about history:

The Greeks had writing. There is a famous Greek story of great heroes and heroic deeds. The name of the story is The Iliad. It is a poem written about a war between the Greeks and the Trojans. The Trojans are people who lived in Troy. For hundreds of years most people thought The Iliad was a story about imaginary people and the things that happened to them.

Heinrich Schliemann, an amateur archeologist, had read and studied The Iliad. He believed that Troy was a real city and not an imaginary one. He thought that The Iliad was the story of a real war. He searched for, found, and excavated the ancient city of Troy in 1871-73.

As a result of excavations, we know more about Greek history. We also know more about Greek prehistory and the beginnings of Greek culture. Archeology is the key to prehistory; it also helps us to know more about history.

Archeology is a Science

Just digging for statues, tombs, and cities is not archeology. Grave robbers and thieves have been doing this for thousands of years. Many thousands of years before modern archeology, grave robbers entered the tombs of the Egyptian pharoahs. They stole many valuable objects from these tombs.

Modern archeology is a science of method and interpretation. Everything is important to an archeologist: the place of the site; where things are found in a site; and what things are found together. The archeologist is not just interested in statues and jewelry. With only a few clues, he is trying to piece together the culture of a group of people. So he is just as interested in the village dump or refuse heap (midden), as he is in the village temple. The bones of animals can tell him not only what the people ate, but what the climate was like thousands of years ago when people had no way of making written records.

The rest of this chapter is to tell you about the scientific methods of anthropology.

ARCHEOLOGICAL SITES

How Artifacts Get Buried and Preserved

Artifacts get buried and preserved in many ways--in caves, tombs, campsites, villages, and cities.

Men lived and stored things in caves. When they died or moved away, things were left behind.

Men buried artifacts in graves and tombs. We know much about the ancient Egyptians because they put many artifacts in graves and tombs for the use of the spirit in after life. An entire wing of the Cairo museum is filled with artifacts from the tomb of the Pharoah Tutanhkhamen in the Valley of the Kings.

An abandoned village or campsite gets covered with dirt blown by the wind. Bushes, vines, and trees may eventually grow over it.

New parts of cities are built on top of older parts. London and Rome are old cities in Europe with many different levels or layers underneath.

Pompeii, a city of the Roman Empire on the Bay of Naples was covered by volcanic ash in A. D. 79. For three days, Mount Vesuvius, a volcano inactive for 700 years, poured out fire, lava, and ash. When the eruption was over, three cities had been buried. They stayed buried under a heavy cover of ashes and lava for hundreds of years. The archeologists began to dig to find one of these cities, Pompeii. Today we can walk down the streets where Romans walked and visit in the houses where they lived. We know much about Roman life in the first century A. D. from the excavations or diggings at Pompeii.

How Archeological Sites are Found

Archeological sites are found in many ways: by chance, by erosion, by looking for sites, and by aerial photography. An archeological site is an area used by man.

A good example of a chance find is the location of the famous Upper Paleolithic cave paintings of Lascaux, France. Four boys were playing ball. The ball went down a hole and a dog followed the ball. The boys followed the dog. They came into a cave with old, old, paintings. They found these paintings by chance.

Erosion can expose long buried sites. At Olduvai Gorge in Tanzania, East Africa, erosion has exposed the oldest remains of fossil man and his culture. Erosion is the wearing away of the land by wind, water, or glacial ice.

Archeologists also look for sites. They ask questions, look at maps, and study old records. This helps them plan where to look. Archeologists divide the area into sections.

They go over each section. This method of locating a site is sometimes called a field survey.

Aerial photography (taking pictures from an airplane) is helpful in locating a site. From the air it is easy to see where the earth has been changed. This shows up in soil color or plant growth.

Site Classification by Location

The archeologist is interested in the location of the site and in the use of the site. Sites are thus classified in two main ways: by location (where the site is) and by use (what was the purpose of the site).

The location of the site often explains why some things have lasted and others have not. Organic material rots in damp climates but may be preserved in dry climates.

Cave sites provide better-than-average chances for preservation. In Lovelock Cave, Nevada, were found textiles, yarn, dried fishes, seeds, sandals, snares, matting, arrows, cane, digging sticks, as well as arrow points, bone awls, and shell beads.

Desert sites, both open and in caves, provide good preservation. Natural drying out of organic materials (dessication) takes place. Lack of moisture stops decay. Some of the best preserved artifacts in the world come from the desert sites--the tombs of Egypt, the caves and pueblos (villages) of the southwestern United States, the coast of Peru, and inner Asia.

Permanently frozen sites are rare. Like the desert, they offer good preservation. In the Altai Mountains of Russia, the tomb of a nomadic chief was found. It was frozen as a solid block of ice. It was excavated by pouring boiling water on the ice. Preserved bodies were found in log coffins. There were ten perfectly preserved horses and many artifacts made from organic materials.

There are also underwater sites, peat bog sites, and jungle sites. Sites in tropical rain forests offer poor preservation because there is much rain and vegetable growth.

Site Classification by Use

The archeologist is interested in how a site was used. These are some uses:

A habitation site is a place where people lived. It might be a city, like Pompeii; a pueblo village; a camp site; or even a cave.

A ceremonial site is a place where people only came for some religious rite or festival. The oracle at Delphi is a famous ceremonial site in Greek history. Rock Eagle, Georgia is a pile of rocks in the shape of an eagle. The Indians used it for ceremonies. The cave painting sites were very probably ceremonial sites.

A burial site may range all the way from a shallow hole in the ground to the elaborate Egyptian tombs. Sometimes the Vikings buried their dead in a burial ship, and covered the ship with a mound of earth. Many Indian mounds in the United States were both burial and ceremonial sites. Etowah Mound, near Cartersville, Georgia, is such a site.

Stone chipping sites are where man made stone tools. Animal kill sites are where animals were hunted and killed. Stone chipping and animal kill sites were used for very special purposes. They give us limited information.

Site Classification by Time

The archeologist also is interested in sites by time. Some of the broad time periods are:

Historic sites are sites where written records are found as well as artifacts. Examples of historic sites in the United States are Jamestown, Williamsburg, and Fort Frederica.

Classical archeology has dealt primarily with Near Eastern and Mediterranean civilizations that used writing. These civilizations left great cities and a wealth of artifacts.

Contact sites refer to sites in which the people had no written records, but were known to other people who did have writing. The Gauls had no writing themselves, but the Romans wrote about the Gauls. The Incas did not have writing, but the Spanish wrote about them. We know much about the Gauls and the Incas, and can better understand the archeological finds, from Roman and Spanish written accounts.

A prehistoric site is one for which there are no written records. Only the artifacts found provide clues for the archeologists.

The Field Survey

A field survey is made after an archeological site is located. The archeologist looks over the site. At this time he does little or no digging. He decides how much time it will take to dig and how many men he will need. If the site is in a jungle, the cost may be great. To survey a jungle site, men may have to walk through thick forests and swamps. The first survey of a desert site may be done by using cars and jeeps.

The archeologist writes up his survey report. He makes maps that describe the surroundings and show the special features. After he has done all this, he decides whether to go ahead with the job of excavating or digging. He decides whether it will be worth the cost and if he can get the money to do the job. Universities and museums often may provide the money for this work.

EXCAVATION

The excavation of a site is done very carefully. The archeologist uses scientific methods. He keeps careful records of each step of the work.

Laying Off the Site

The first step in excavation is to lay off the site. The archeologist uses pegs and strings to lay the site off into squares. These squares help him to locate the exact places where artifacts are found when the digging begins.

The archeologist may dig straight down in clay soil. The clay walls of the dig may be vertical (straight up and down). In loose soil, or if there is much rain, the digging is done so that the walls are like steps. This is to keep the walls from caving in.

Methods of Excavation (See Illustration page 10)

Basic methods of excavation are trench, pits, quadrant, and total excavation. One or more of these basic methods may be combined, as shown in the picture on page 10.

Trenching involves digging a ditch through the site from top to bottom. It is very useful in showing the stratigraphy of the site (how many layers there are).

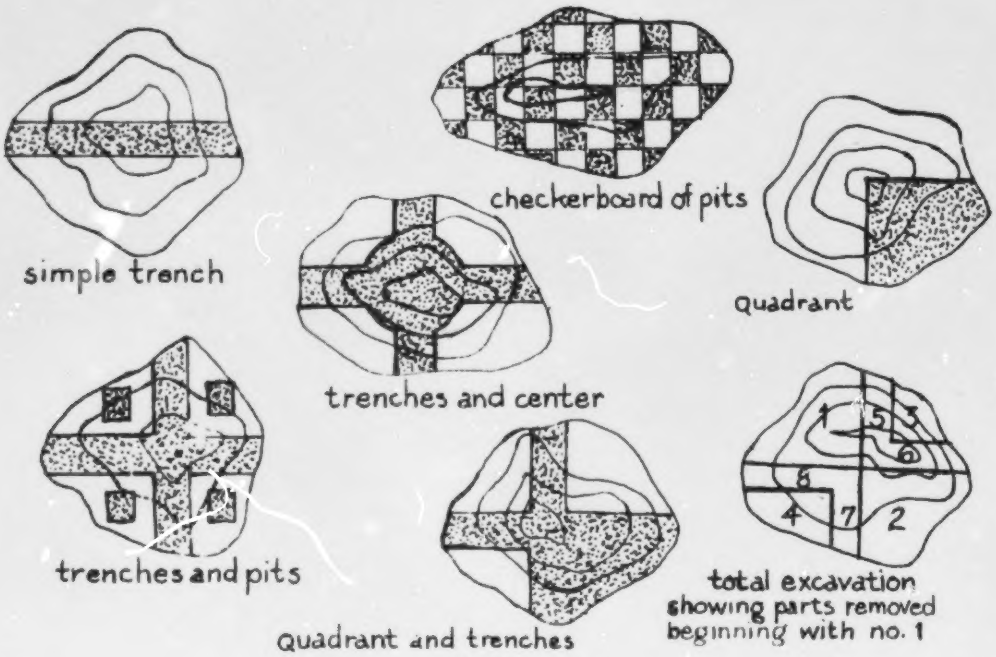
A checkerboard of pits is used in the excavation of a shallow site. The site is laid off into five- or ten-foot squares, and digging is done in every other square.

A quadrant is the excavation of one-fourth of the site area.

Total excavation of a site provides the most complete record.

Archeological Tools (See Illustration page 11)

The archeologist uses many kinds of tools to excavate. A bulldozer may be used to move thick layers of dirt or stones. Shovels or picks are used too. Dirt can be taken away in wheelbarrows or baskets. Dirt is run through a screen or sieve. Many small articles are found by sifting loose dirt through a screen.


simple trench
checkerboard of pits
Quadrant
trenches and center
trenches and pits
Quadrant and trenches
total excavation
showing parts removed
beginning with no. 1
1
5
3
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8
4
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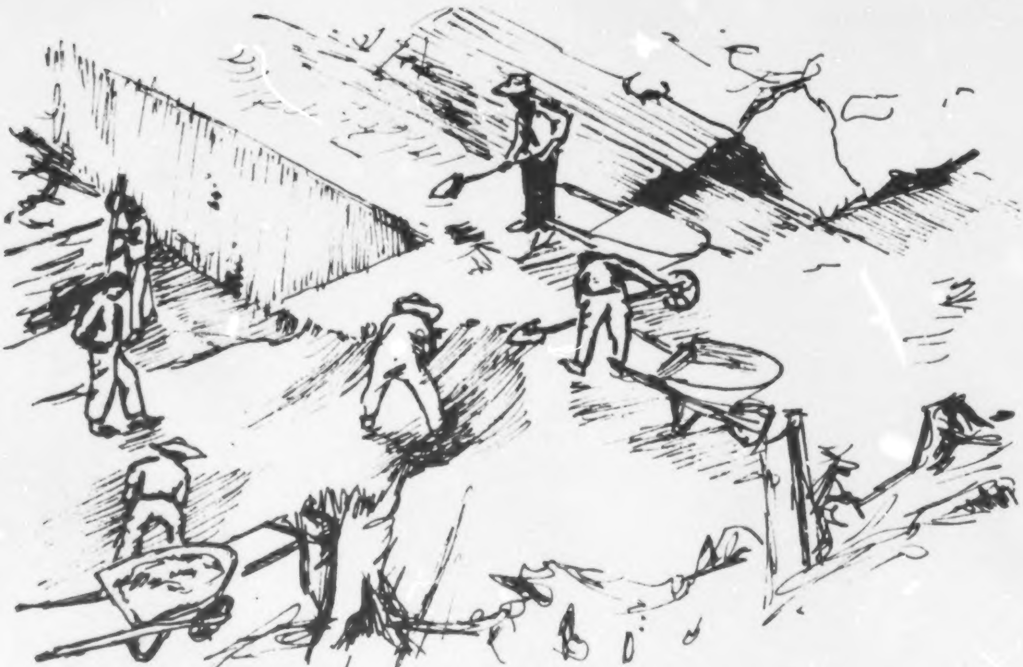
2

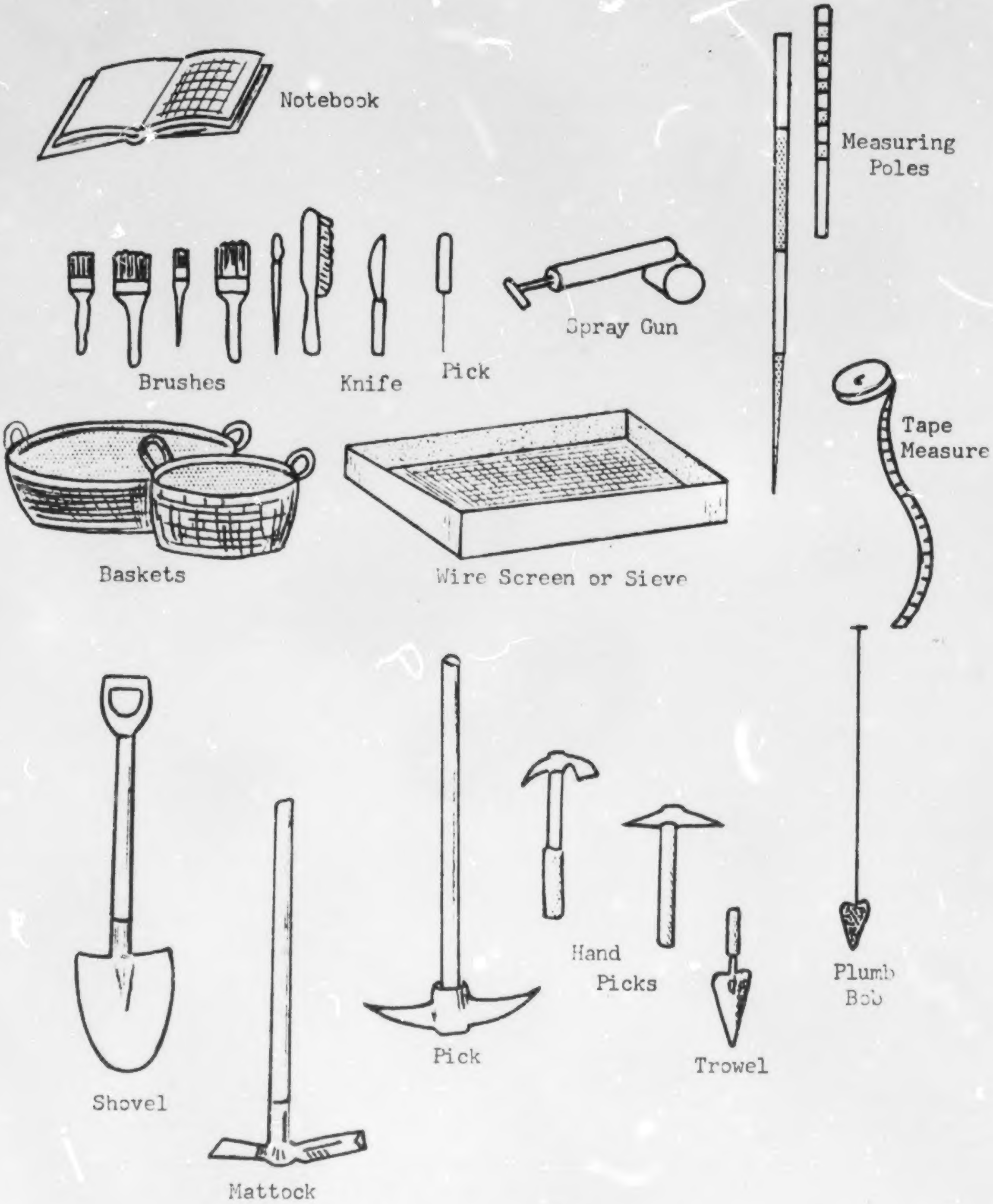
Methods of Excavation

(The Darkened Area is Dug Out)



Rough Excavation With Shovels

TOOLS USED FOR EXCAVATING


Notebook
Measuring Poles
Brushes
Knife
Pick
Spray Gun
Tape Measure
Baskets
Wire Screen or Sieve
Shovel
Mattock
Pick
Hand Picks
Trowel
Plumb Bob

When an object is found in the earth, smaller tools are used to remove the dirt around it. The archeologist uses trowels, brushes, and pointed tools like an ice pick. A tape measure is used to locate the spot where the object is found. The location is written in a notebook. Pictures are made of the object. The object or artifact is numbered. It is then taken to the laboratory for further study.

Personnel

People on an archeological expedition include at least one archeologist. Often there are others training to be archeologists. Excavation should only be done by a trained archeologist.

The hard work of removing the earth is done by diggers. Most of these must be trained on the spot. In some countries which are rich in archeological sites, digging is a trade handed down from father to son. Experienced diggers are most helpful in an excavation. They can sometimes tell the kind of artifact struck when the shovel touches it. When an object is struck, digging proceeds carefully, using smaller tools.

Record Keeping

A very important task of the archeologist is to keep accurate records. Before an object is removed from the earth, he writes in a notebook all he can about the object. Where was the object found? How deep in the earth was the object? What other things were found near it? Exact measurements are written down. Pictures are made of the object. All of these are part of the record.

Sometimes the archeologist finds evidence that an artifact was there. Ghost objects are carefully described. Very often ghost objects are discolorations in the soil. This difference in soil color may be from the decay of organic material or metal objects. Post holes of an early Iron Age house in Jutland show this discoloration where the wooden post decayed and left the soil a different color.

In digging down in the earth, the archeologist finds different layers such as soil, clay, or rock. These layers are called strata. Pictures are made of these strata. These show up better in a picture if the different strata are first treated. The archeologist may roughen the surface by scratching lines on the different strata. All pictures need a scale to show the relation of the size of the find and its location. A measuring stick, marked in one-foot lengths, is useful. Everything in the picture of importance is labeled. Refilling the excavation is sometimes required after an excavation is completed. At Etowah, Georgia, the owners required the excavators to restore the mounds to their original shape.

DATING

An important job of the archeologist is to find out the age of the site and the age of the artifacts found in it. The archeologist must know the dates of objects and of the site in order to interpret the find and to relate it to the other things known about the past. He makes use of two methods of dating--absolute and relative.

Absolute dating gives a more or less fixed year, such as A. D. 1,000. Many absolute dates are actually approximate dates or estimated dates with a margin of error, as with dates from the Carbon 14 method. For general purposes, however, such dates are treated as absolute dates.

Relative dating does not give a fixed year. Relative dating can only tell whether an object or site is older than some other object or site. It can tell if something is less old than another thing. Methods of relative dating include stratigraphy, seriation, biology, and geology.

Stratigraphy is a way of telling whether an object is older or less old by the strata (layer of earth) in which it is found. An object found in an upper layer, closer to the surface of the earth, would probably not be as old as an object found in a lower layer farther down. The upper strata are built up over long periods of time over the lower strata. Lower strata were there first. That is why we say they are older than the upper strata.

Seriation is a means of type dating. What series or styles of pottery does the object belong to? What series or style describes an arrowhead that is found? Differences in shape or design are clues to the series. Similarities in color, design, texture, material, and workmanship, are clues used in seriation. You use seriation to tell the model of a car from its shape. The archeologist uses his knowledge of biology to date things. The flora or plant life of an area of the world changes over many years. The fauna or animal life also changes with time. A scientist who studies ancient plant and animal life is called a paleontologist. He can help the archeologist date objects and sites.

Man-made objects found with remains of old animals and plants help us to know the time the man lived there. The Folsom spear points found in New Mexico have been dated as from the close of the Ice Age. They were found with the remains of an animal that lived long ago. From this we know that the Indian was already in North America many thousands of years ago.

Geology is another science used in dating objects or sites. The level of the seas has risen and fallen during the periods of the glaciers when great sheets of ice covered the earth in different places. Different flora and fauna (plant and animal life) existed in these old times or geologic ages. Climate has changed over thousands of years. Land that was above water long ago is now under the sea. The Bering Strait (between Alaska and Siberia) was a land bridge a long time ago. Now the sea covers it. During the time it was a strip of dry land, the Indians migrated from Asia to North America.

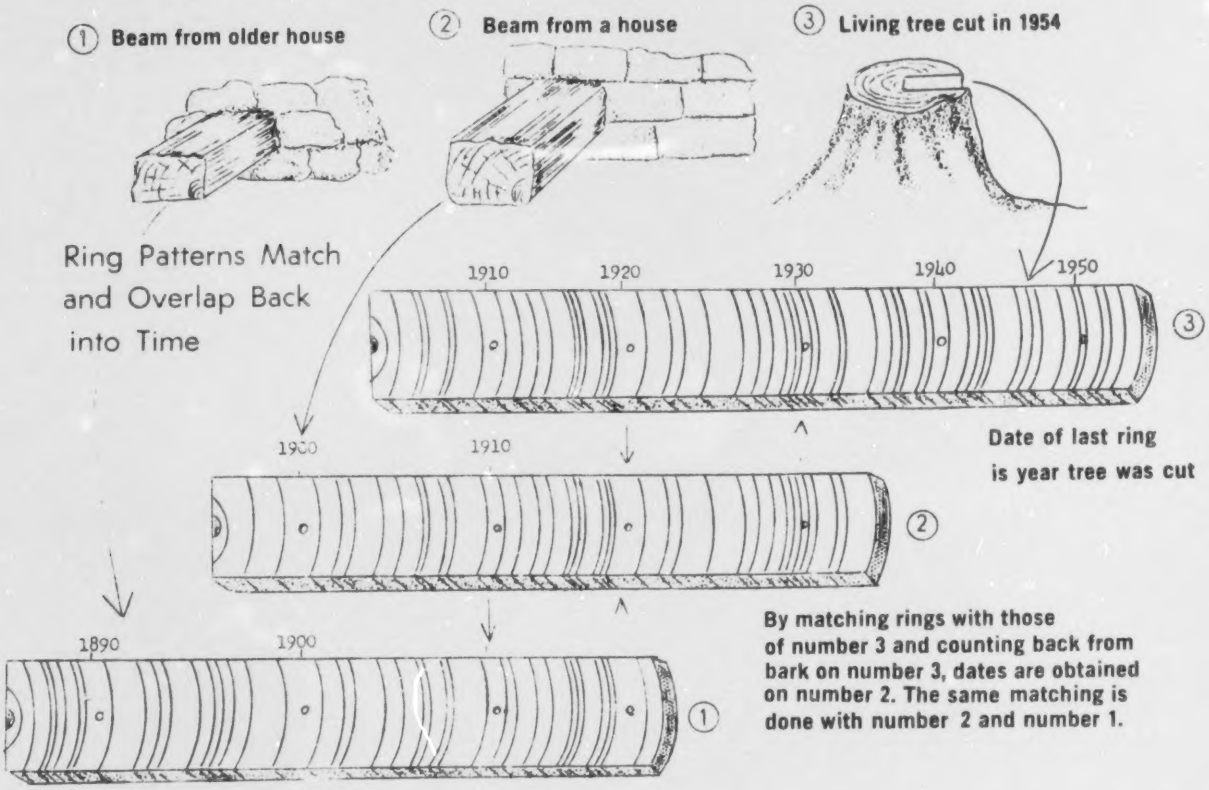
Absolute Dating

Methods of absolute dating include calendrical, dendrochronology, carbon 14 dating, and potassium-argon.

Calendrical dating is done using different calendar systems. Man has used many different kinds of calendars to mark the seasons, the months, and the days. The archeologist must know about these different calendars so that he can tell how old an object or a site is.

Dendrochronology is tree ring dating. When a tree is cut, we can see a number of rings in the inside of the trunk. Each of these rings represents a year of growth of the tree. By counting the rings you can tell how old the tree is. Archeologists working in the southwestern United States have found dendrochronology dating very useful. Dendrochronology dating gives the age of a piece of wood found at a site. It does not tell the archeologist the age of the site itself because the wood may be older than the site. Many times old wood is used in building a new house.

DENDROCHRONOLOGY - TREE RING DATING

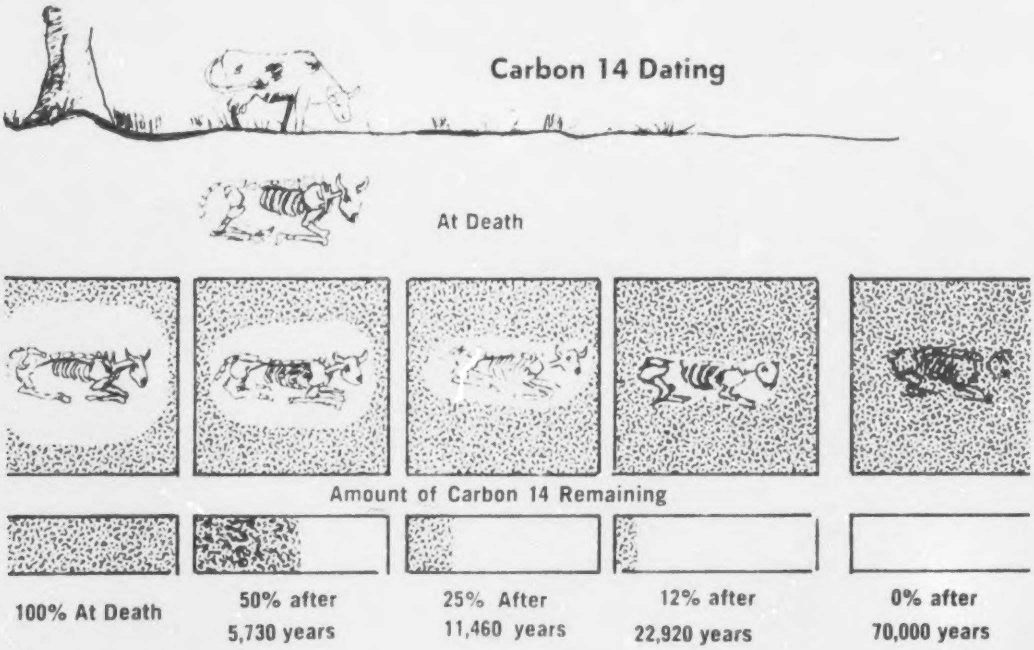

① Beam from older house
② Beam from a house
③ Living tree cut in 1954
Ring Patterns Match and Overlap Back into Time
1910
1920
1930
1940
1950
③
Date of last ring is year tree was cut
1900
1910
②
1890
1900
①

By matching rings with those of number 3 and counting back from bark on number 3, dates are obtained on number 2. The same matching is done with number 2 and number 1.

Carbon 14 dating is used more often for absolute dating than any other method. This can be used to tell the age of organic material. All living things, plants or animals, contain some of the element carbon. All living things also contain radioactive carbon, which we call Carbon 14. We know the amounts of this radioactive carbon in living plants and animals. We can measure the amount in dead organic material. The difference in these amounts tells the archeologist how old the material is. The older the material, the less the amount of radioactive carbon there is. Sometimes the amount of Carbon 14 is too small to measure. If the organic material is older than 70,000 years, the Carbon 14 dating method cannot be used.

Carbon 14 dating was used on the Dead Sea Scrolls by testing the radioactive carbon in the parchment (organic material of dead animal skin) which was wrapped around the scrolls. The date of these scrolls is A. D. 40.

Charcoal found at Stonehenge, England, is dated at 1500 B. C. Sandals found in Newberry Crater, Oregon, are 7,000 B. C. Remains of roasted animals found in Russell Cave, Alabama, are 7,000 B. C. All of these are organic materials which have been tested using the Carbon 14 method.


Carbon 14 Dating
At Death
Amount of Carbon 14 Remaining
100% At Death
50% after 5,730 years
25% After 11,460 years
12% after 22,920 years
0% after 70,000 years

Potassium-argon dating can be used in dating things that contain the element potassium. Over millions of years potassium decays at a regular rate into another element called argon. The amount of potassium and the amount of argon in a rock may tell the archeologist the age of the rock. The value of this method is that rocks of a site may be dated. The age of Zinjanthropus, an early man, is known by using this potassium-argon method to date the rocks containing his fossil remains. The remains of this early man found in East Africa are dated at about 1,750,000 years ago.

FINAL WORK FROM AN EXCAVATION

Excavation is one of the most exciting parts of archeology. The find, however, must become a part of our knowledge if it is to fulfill a scientific purpose. Laboratory work, interpretation, and publication are three important final steps in archeology.

Laboratory Work

The type of laboratory work done at the site is determined by the size of the expedition and the amount of money. If the dig is a large one, much laboratory work may be done at the site. If the dig is small, artifacts may be packed and shipped to a museum laboratory. Important kinds of laboratory work are cleaning, dating, preservation, restoration and description.

Cleaning is done in several ways. One of the commonest methods, for objects that will not be damaged by water, is washing. Stone and pottery objects are usually washed.

Dating is a part of laboratory work. Dating by Carbon 14 and potassium-argon methods, as noted before, requires specially equipped laboratories. Such dating is not done at the site.

Preservation is necessary to keep wood, bone, or other materials from falling to pieces when dug up. This is most often done at the time the object is exposed to the air.

Artifacts are treated with different kinds of preservatives. Lacquer, glues, and other substances are used.

Restoration is the process by which broken artifacts and artifact traces are put back together. It is more common to find broken or decayed artifacts than whole ones. In order to interpret such pieces, they must be fitted together. In the laboratory a technician will carefully and painstakingly put together bits of broken pottery, metal, or wood. Under his patient hands a finished or partly finished object emerges--a shield, a piece of pottery, a piece of jewelry, or a weapon of some kind. Such reconstruction is an essential part of archeological work.

Description is the final step in laboratory work. This involves measurement of the artifact, finding out its material composition and how it was made, and other related information. Accurate information is recorded in a laboratory or museum record. Such description is essential for the next step of interpretation.

Interpretation

At every stage of his work, from the field survey to the final step of laboratory description, it has been emphasized that the archeologist keeps careful records. In his records are a description of objects, the measurements of where they were found, and pictures and sketches of the artifacts and strata in which found.

From all of this material he begins the job of interpretation. He must explain what he has found. He must describe the culture of the people from all the things he has discovered. This is not an easy part of his work.

If a lot of broken pottery has been found, the archeologist knows the people used pottery. If a large number of grinding stones has been found, the archeologist will interpret this find as a clue to grain used by these people. If many bones of wild animals are found in charred (burned) remains of a campsite, the archeologist will interpret this to mean that the people were hunters. The study and interpretation of what is found is a most important job of the archeologist. He has had long years of study and training to help him interpret or explain his findings.

Publication

After the excavation is finished and the archeologist writes up his findings or his interpretation, he then needs to tell other scientists about it. Publication of his findings is necessary. When he publishes his findings, they are printed in books and journals. These are read by other scientists interested in this work. The reports of findings of anthropologists are usually printed in journals of anthropology or journals of archeology. They are often written again in books or magazines or newspapers that we read. Sometimes they are in story form. You will find many very interesting books about archeology and anthropology that are in the school library. These are written for children and young people.

SUMMARY AND A WARNING

Archeology is a fascinating study. It is man in search of his past. When an archeologist helps tell the story of man's past he also creates a wider and better understanding of man.

Because you have studied something about archeological methods does not mean that you ought to try to dig a site. Archeology is a science. It takes years to train an archeologist. It is easy to describe archeological methods. It makes it sound as if archeological work is easy. It is not. Many valuable archeological sites have been ruined by untrained diggers.

If you find an archeological site, do not try to excavate it. Contact the museum nearest you, the state or local archeological society, or archeologists at the university in your area.

EVOLUTION

Evolution and Anthropology

Evolution is a scientific explanation for the origin and development of living things. Anthropology is the study of man. Anthropologists study evolution because evolution is a scientific explanation for the origin and development of man.

As a science, anthropology has two main divisions--physical anthropology and cultural anthropology. Physical anthropology is the study of man as a member of the animal kingdom. This animal, man, has skin, muscle, bones, eyes, hair, as well as other organs. Man can be studied in terms of his structure (anatomy). He also can be studied in terms of function (physiology).

Man differs from other animals in several ways. He speaks a language. He makes tools. The way of life of a group of people is called their culture. The development of speech and tools mark the beginnings of culture. Cultural anthropology is the study of man in relation to culture.

Not until historic times did man leave a record of his speech, in the form of writing. But anthropologists believe that man appeared in prehistory because of the tools he left behind. Such tools are sometimes found with the remains of fossil man. The discovery of tools near human-like remains helps to identify the remains as human.

Evolution is a word which scientists use to explain a slow change or development in organic or living things. But the word evolution is also used to describe other kinds of change--such as social change. Sometimes confusion results when the idea of organic evolution is applied to other changes. In this chapter evolution applies only to organic changes. Organic changes are changes in plants and animals.

Foundations of Evolutionary Thought

A scientific explanation of organic changes in animals was made by an English scientist, Charles Darwin (1809-1882). His explanation is called natural selection.

Many scientific developments had occurred which helped Darwin in his work. A binominal system of classification had been worked out. In a binominal system, each species is known by two names, the genus name and the species name. The scientific name of modern man is Homo sapiens. Classification helped naturalists see how things are alike and how they are not alike. There are many variations or differences in the same species. No two men are just alike.

Another development was in comparative anatomy. Anatomy refers to the structure of animals. Comparative anatomy is the study of how animals are alike and unlike in their structure. Comparative anatomy helped scientists to see from the fossil bones of animals that many species no longer lived. Many species had become extinct. Extinct means that they had died out.

Scientists also learned about differences in the earth's crust. Tops of some mountains are made out of sedimentary rock which contains sea shells. These mountain tops must once have been at the bottom of the sea. Sedimentary rocks are rocks formed from the wearing away of the earth's crust by erosion. Sediment consists of mud, sand, gravel, and soil carried by rivers, winds, and glaciers. Under tremendous pressure, sediment is made into sedimentary rock. Sedimentary rock is made up of layers of different sediment. It is made up of strata. Geologists developed the idea of stratigraphy. The principle of stratigraphy (see "Archeological Methods") is that the bottom layers are older than the top layers. Sedimentary rocks often contain fossils. Animal and plant matter got mixed up in the sediment.

Geologists also reached the conclusion that the earth is very old, much older than men had ever thought. They also developed the idea that the forces making the earth what it is, are still at work. The geologists found many fossils in sedimentary rock. These fossils indicated that living things were much older than anybody had ever imagined. The science of paleontology, the study of old living things, had begun.

A system of classification, an idea of species variation, comparative anatomy, sedimentary stratigraphy, and historical geology all provided Darwin with tools to think about organic changes in animals.

Darwin and Natural Selection

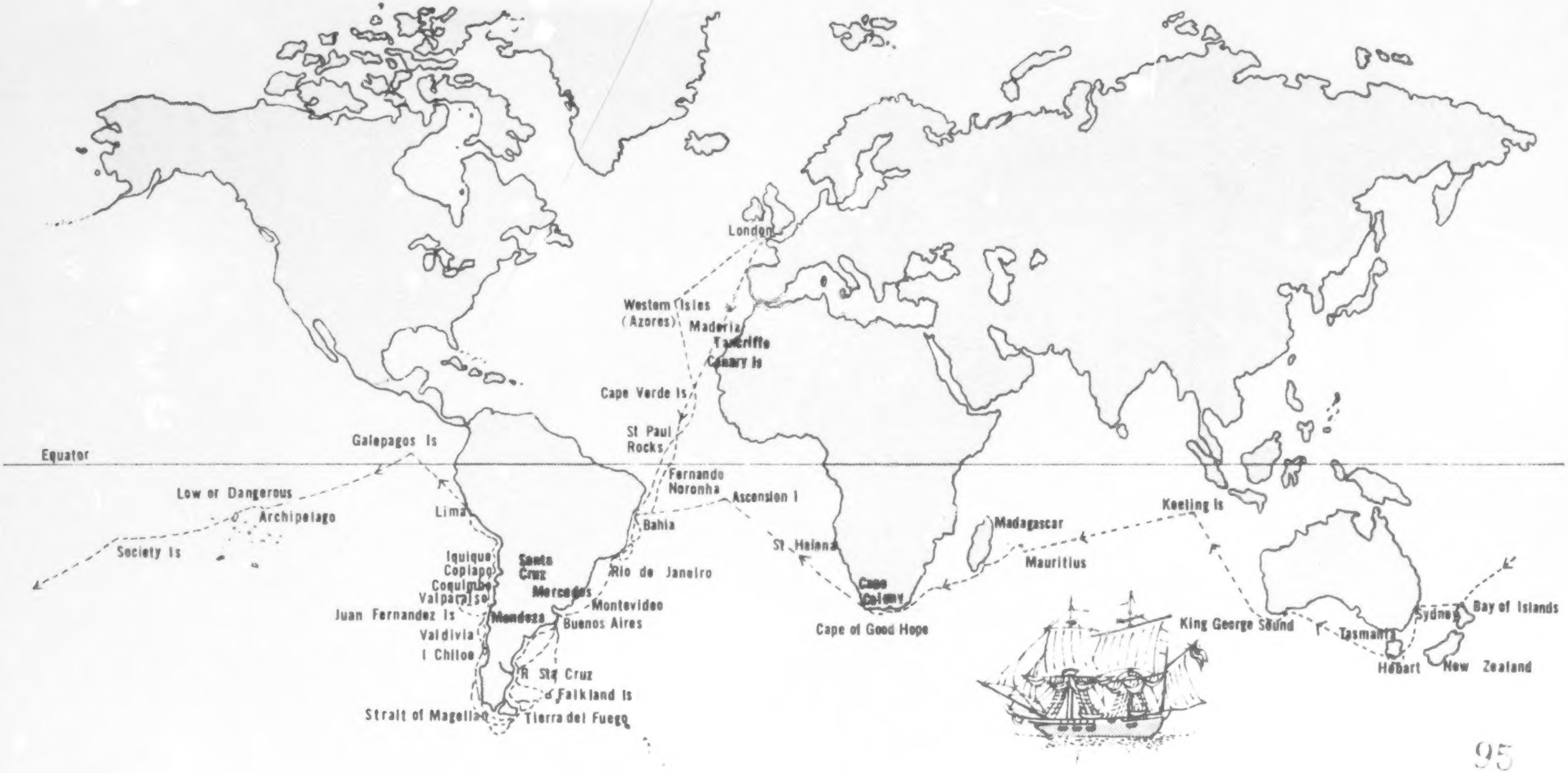
In the early part of the nineteenth century the English government sent a scientific expedition to study the coasts of South America and some of the Pacific Islands. The expedition traveled in a ship called the Beagle. Darwin was the naturalist of the expedition. In the nineteenth century a naturalist was a general scientist who studied zoology, botany, geology, and anything that had to do with things that lived or once lived. (See Illustration on page 24)

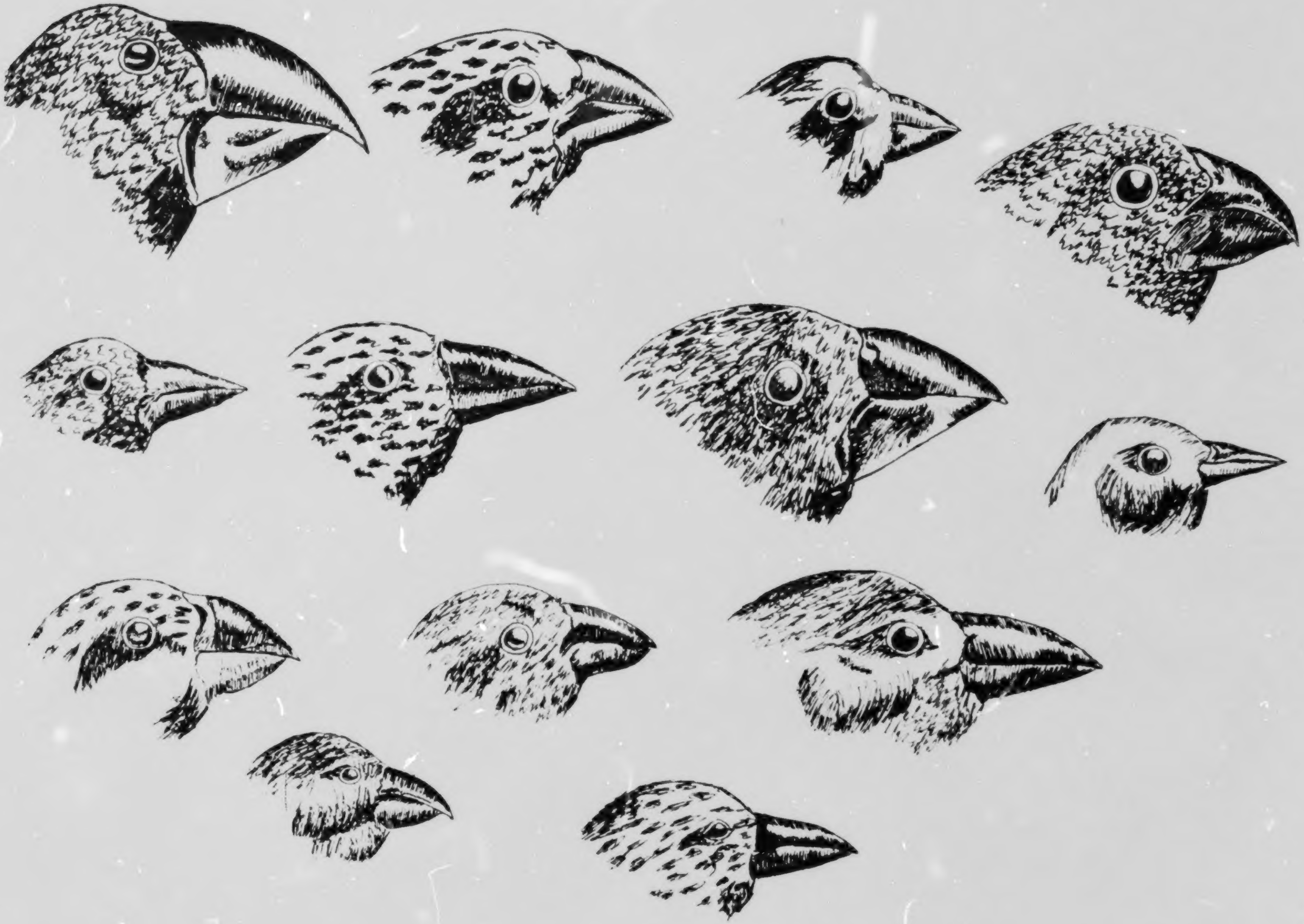
On this trip Darwin came across many things that made him ask over and over again "Why do species vary with their environment? How do these changes come about?" On the Galapagos Islands off Peru he found many species of the finch bird, each species with a beak adapted or suited to a particular eating habit. (See Illustration on page 25)

After he got back to England, Darwin studied the work of Thomas Malthus. Malthus was a political economist. He was mainly interested in the relationship of the human population growth, food supply, and poverty. Malthus wrote that population increased faster than the food supply. He said that disease, famine, and other disasters were checks to population growth. If there were no such checks, he believed all people would be reduced to poverty. This principle is known today as the Malthusian theory.

Darwin took this idea of Malthus and applied it to his own work. He knew that a much greater number of eggs were laid than were ever hatched. He knew that plants had far

Voyage of H.M.S. Beagle, 1831-1836


London
Western Isles
(Azores)
Maderia
Teneriffe
Canary Is
Cape Verde Is
St Paul
Rocks
Galepagos Is
Equator
Fernando
Noronha
Ascension I
Low or Dangerous
Archipelago
Society Is
Lima
Bahia
St Helena
Madagascar
Mauritius
Keeling Is
Iquique
Copiapo
Coquimbo
Valparaiso
Juan Fernandez Is
Santa
Cruz
Mercedes
Mendoza
Rio de Janeiro
Montevideo
Buenos Aires
Valdivia
I Chiloe
R Sta Cruz
Falkland Is
Strait of Magellan
Tierra del Fuego
Cape
Colony
Cape of Good Hope
King George Sound
Tasmania
Hobart
Sydney
Bay of Islands
New Zealand



Finches of the Galapagos Islands

more seeds than ever grew into new plants. Far more plants sprouted, and far more animals were born, than actually survived. Darwin thought that excess reproduction--more than could survive--must be the key to evolution. In short, the organisms that survive are best adapted to their environment. Those which are less adapted to their environment are less likely to survive and have offspring. Natural selection, therefore, results from adaptation to the environment. The science of heredity had not yet developed, and Darwin still did not know the cause of the variation, or difference among, the same species.

Recognizing the weakness in his explanation, he spent over twenty years collecting evidence to test it. He studied breeding in animals through artificial selection. He studied barnacles and found other evidence for evolution. He studied the fossil record and compared the structure of different animals. A fossil is the remains of an organic material which has been transformed into mineral matter. His explanation of evolution provided a unity of thought that had been previously lacking in the way man looked at nature.

In 1859 Darwin published the first edition of one of the greatest works in the history of science. The name of this classic is On The Origin of Species By Means of Natural Selection. The great contribution of Darwin is not the originality of his thought. It is the mass of evidence which he scientifically accumulated to support his explanation of the evolution of plants and animals by natural selection.

Much scientific work in related fields had preceded Darwin, and since publication of Origin of Species, there has developed a synthetic explanation of evolution. A synthesis is something made up of different parts and put together in a clear and logical manner.

Modern Synthetic Explanation of Evolution

Scientific knowledge about organic processes has greatly increased since the time of Darwin. Laws of inheritance, the development of new genetic material through mutation, and th principles of genetic drift, migration, and gene pools have been developed. These principles have not caused biologists to abandon natural selection as a part of the explanation of evolution. But natural selection is no longer viewed merely as the survival of the fittest. A complete explanation of the modern synthetic explanation of evolution would take us far astray into the science of genetics, or heredity. In this section only some of the factors can be presented.

Inheritance and Genes

The characteristics of a plant or animal come from, or are inherited from, the parents. These characteristics are controlled by heredity. The chemical unit which controls heredity is called a gene. The number of genes differs in various animals and plants. One-half of the genes comes from each parent. Genes control the appearance of the plant or animal. The characteristics passed from parents to offspring are the result of how the genes from the two parents combine.

Inheritance is very complicated because life characteristics are not controlled by one gene, but thousands of genes working in combination. Such things as height, weight, and color are controlled by many genes.

The science of genetics is a very specialized field of biology. Anthropologists are interested in genetics because it helps to explain how new types of men are formed.

Mutations

Principles of heredity explain the origin of new species. Mutation offers an explanation for sudden, drastic changes in evolution.

Mutation is simply the change in the chemical structure of the gene. These changes are transmitted to offspring. Mutations are the source for new genetic material. Together with natural selection, mutation provides the basis for evolution. Most mutations are harmful, and result in the death of the organism. Some mutations are desirable. Short-legged sheep and polled (hornless) cattle are two examples of mutations selected for inbreeding.

The relationship of mutation and natural selection in the evolutionary process is shown by the moths near Lancaster England. When first observed, most of these moths were light colored. Occasionally, a dark mutant appeared. At this time the bark of the trees was light colored. Over a period of years, the smoke from the factories discolored the bark. The birds could now more easily find and eat the light colored moths. Natural selection favored the survival of the dark moth. Today, most of the moths are dark colored. The evolution of a new species thus involves both mutation and natural selection. (See Illustration on page 29)

Genetic Drift

Genetic drift results from the accidental loss of genes. It usually occurs in small, isolated populations. Suppose only one Eskimo hunter in a group carries the gene for blue eyes. He has no children. He is lost at sea. There is no longer any possibility of a member of the group being born with blue eyes. Through the accidental loss of certain genes there is a possibility of genetic drift.

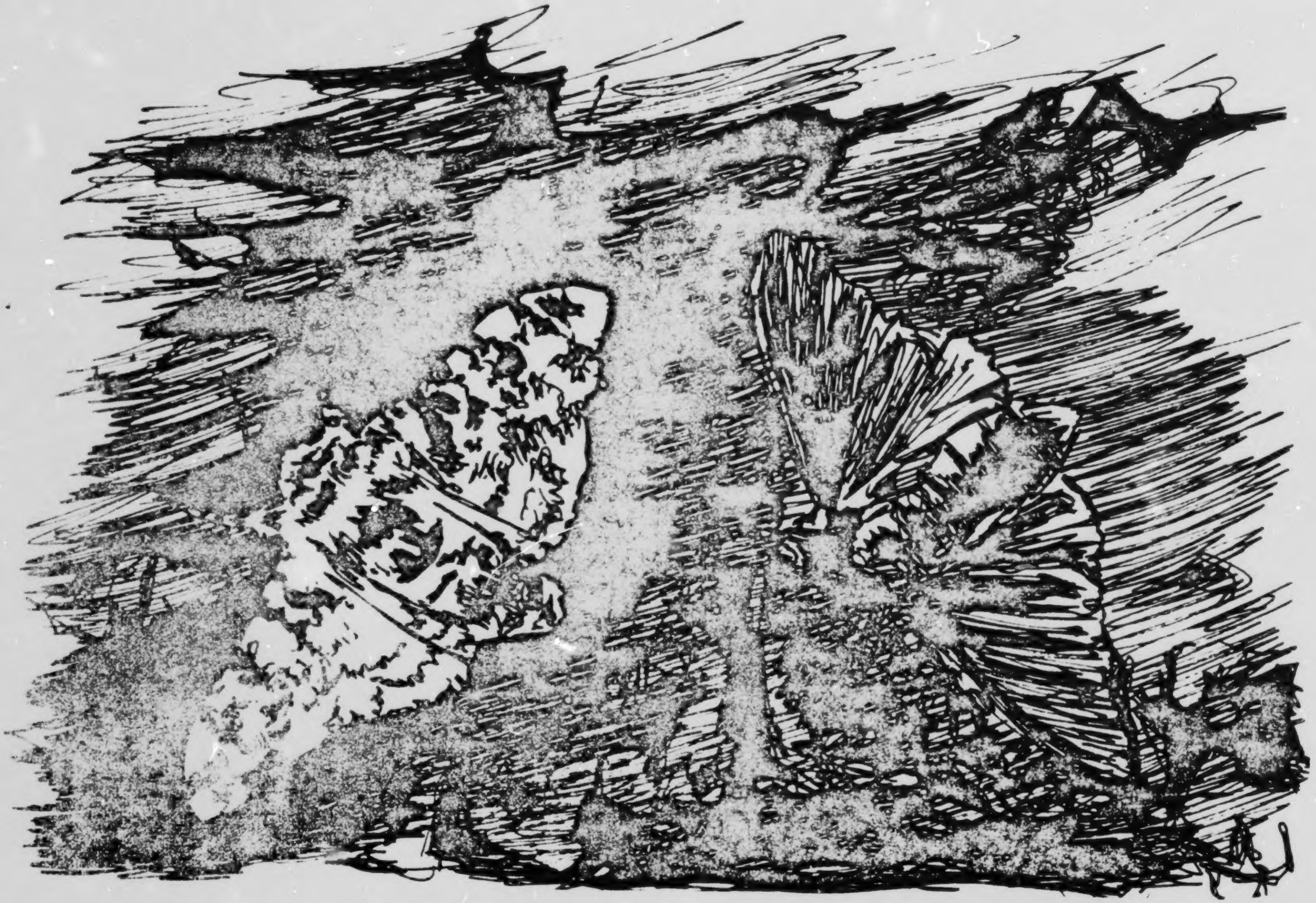
Migration

Migration is coming into, or going out of, a population. This migration may add to, or subtract genes from the population.

Specialized and Generalized Animals

In the course of evolution specialized and generalized animals have developed. Generally, the more specialized an animal, the more easily it is able to use a particular environment. But at the same time, the less suited it is to other environments. Man is a generalized animal. He is less specialized than many other creatures. He is one of the most widely distributed animal species on earth. Man's culture is

THE INDUSTRIAL MOTH



A Light Colored Industrial Moth and A Dark Colored Mutant an important factor in his ability to adjust to his environment. In fact, through culture, man does not merely adapt to, but actually creates, new environments.

Fossils and the Evolution of Life on Earth

Modern methods of rock dating place the age of the earth at about 4.5 billion years. Life has been on earth for over 500 million years. Remains of ancient plant and animal life in the form of fossils are the only record of ancient life. (See Chart on page 31)

Fossils are remains or traces of plants or animals which lived in a prior period. The most common form of preservation was to be covered by sediment. Pressure has changed the sediment, and fossils, into rock. Except for drilling and mining operations, fossils found in rocks have nearly always been uncovered by geologic forces such as earthquakes and erosion. Generally, only the hard parts of animals, such as the bones and teeth, have been preserved.

From little evidence, however, paleontologists have been able to gain much insight into prehistory. The paleontologist draws upon the skills of many sciences. He uses dating methods from physics, infers climate from plant and animal forms, uses chemistry to find out the composition of material and uses comparative anatomy to reconstruct animals.

New knowledge is added to the old, giving a broader base for study. Some fossils have been found in undisturbed deposits with no datable remains and others with no trace of related things. However, the fact that there are several sets of skeletal remains for most major fossils helps in the identification of new finds. For example, Dart set up a new genus, Australopithecus africanus, on the basis of a 1925 discovery of a skull of a six year old child. Later finds of adult fossil remains of Australopithecus supported his classification. Australopithecus is discussed in the following chapter.

GEOLOGIC TIME CHART

Geological Chronology		Began ______ years ago	Events
CENOZOIC (Age of the Mammals)	Holocene	10,000	Rapid expansion of human culture.
	Pleistocene	1,000,000	Extinction of many large mammals. Homo sapiens appears.
	Pliocene	12,000,000	Australopithecus appears.
	Miocene	30,000,009	Great expansion of the great apes (family Pongidae).
	Oligiocene	40,000,000	Evolution of modern mammals and first hominoidea.
	Eocene	60,000,000	Primate evolution begins-horse ancestor Eohippus appears.
	Paleocene	75,000,000	Rapid evolution and expansion of mammals.
MESOZOIC Reptiles	Cretaceous	120,000,000	Extinction of dinosaurs.
	Jurassic	155,000,000	First primitive mammals and birds appear. Dominance of the dinosaurs.
	Triassic	190,000,000	Evolution of dinosaurs as progressive reptiles.
PALEOZOIC Age of ancient life	Permian	215,000,000	Great expansion of the reptile groups.
	Carboniferous	300,000,000	Reptiles evolve from the amphibians. Expansion of the amphibian life.
	Devonian	350,000,000	Amphibians evolve from fish. First land animals.
	Silurian	390,000,000	First known land plants.
	Ordovician	480,000,000	First fish-like vertebrates.
	Cambrian	550,000,000	Invertebrate life in oceans and seas.

Pre-Cambrian 4.5 billion Little evidence of fossils
Beginning of the earth

There is a limit to reconstruction, even where the fossil record is fairly complete. The height, weight, body build, and posture can be estimated. From the brain case, the brain size may be estimated and a clue found to intelligence. But as for the skin, hair, and eye color, we can only guess. *Artistic reconstruction of such traits is imaginative and is not based on scientific evidence*.

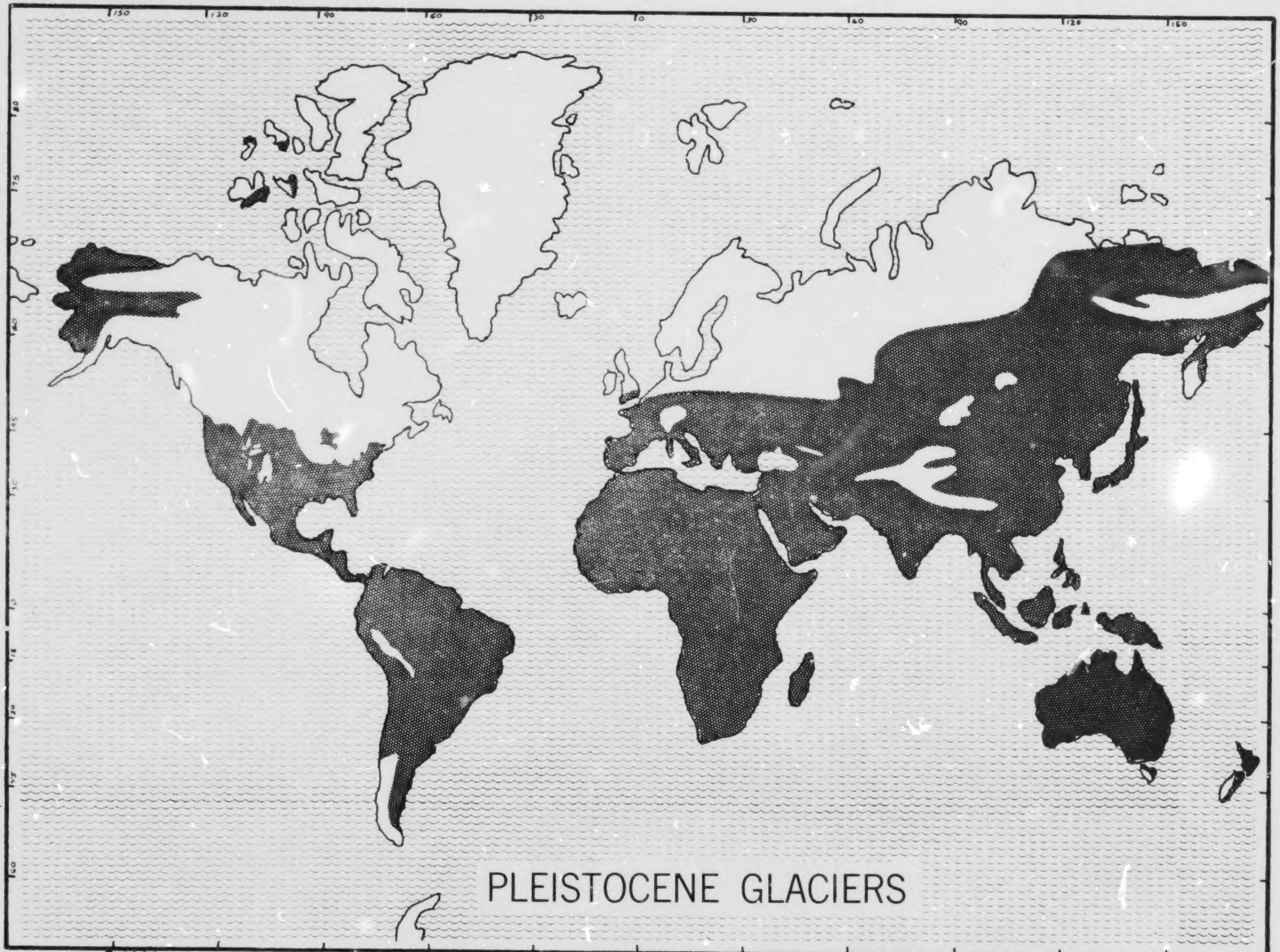
Life on earth began over five hundred million years ago during the *Cambrian* period. The main features of the various periods are given in the time chart. It was not until the *Paleocene* Epoch, 75 million years ago, that mammals became numerous. Fossil man appeared in the late *Pliocene* or very early *Pleistocene* epochs. (See Chart on page 31)

The Pleistocene Epoch is the period of the Ice Age. It began about a million years ago and lasted until the *Holocene* Epoch, the beginning of modern times. During this period, much of the northern hemisphere was covered four times with glaciers like those covering Greenland. (See map on page 33)

The ice sheets had a great and lasting effect upon land forms and the climate. So much water was frozen in the ice sheets that the level of the seas was lowered. During this time England was connected to Europe, Siberia joined Alaska, and most of the Mediterranean was a land bridge between Africa and Europe.

The climate was also much colder throughout the northern hemisphere. Warm climates were found only near the equator. The *Pleistocene* was not a period in which there was just one glacial advance. There were four advances and retreats of the glaciers. Before the first, there was a long period of slight cooling and heavy rainfall. Then, between each of the four glacial periods there were three warm periods (*interglacials*). The climate in Europe in the interglacial periods was as warm as it is today, if not warmer.

It is difficult to date these distant times precisely. *Pleistocene* time is frequently stated in terms of the periods of glaciations and interglacials. These provide a framework


150
120
90
60
30
0
30
60
90
120
150

PLEISTOCENE GLACIERS

for the relative dating of fossil finds. The remains of fossil man are frequently found in glacial deposits. Dating by geologic events gives a relative date for their occurrence. A second method for dating the Pleistocene is by paleontology data. Paleontology is important to an understanding of the environment in which fossil man lived, but is a less satisfactory dating method than by geologic events. (See page 35)

The Pleistocene saw the evolution of mammals, larger than their present forms. During the four glacial periods, plants and animals in Europe were of the type accustomed to arctic weather. During the interglacials, Europe was inhabited by animals similar to the kind found in Africa today, with arctic animals only in the extreme north. By the beginning of the Holocene Epoch, 10,000 years ago, plant and animal life had become essentially as it is today. The next section describes how man developed in the Pleistocene.

EUROPEAN CLIMATE AND ANIMAL LIFE DURING THE PLEISTOCENE AND HOLOCENE

Paleontological Chronology	Geological Chronology	Typical Animals
HOLOCENE 10,000 years ago	HOLOCENE EPOCH (Modern Times)	Modern animals in present ranges.
UPPER PLEISTOCENE 190,000 years ago	4th Glaciation (Wurm)	Woolly mammoth and rhinoceros, bison, great ox and musk ox, horse, cave bear, artic fox, and other artic animals
	3rd Interglacial	Hippopotamus, straight tusked elephant, brown bear, beaver, lion, leopard, red deer, giant elk.
MIDDLE PLEISTOCENE 180,000 years ago	3rd Glaciation (Riss)	Wooly mammoth and rhinoceros, bison, reindeer, musk ox, other arctic animals.
	2nd Interglacial	Macaque monkey, rhinoceros, deer, first straight tusked elephant, great ox, bison, modern species of horse.
	2nd Glaciation (Mindel)	Artic animals
LOWER PLEISTOCENE One million or more	1st Interglacial	Macaque monkey, sabre-toothed cat, elephant, two types of rhinoceros, red deer, hippopotamus.
	1st Glaciation (Gunz)	Arctic animals
	Preglacial (Villafranchian)	Macaque monkey, great sabre-toothed cat, mastodon. First of the true elephants. First of the true horses.

NOTE: This chart is intended as a rough approximation only. Local conditions caused considerable differences in climate and in plant and animal life.

FOSSIL MAN

The chapter on "Evolution" told how changes take place in animals. Man is one of the animals that changed over a long period of time. The Modern Species of man is Homo sapiens sapiens. He did not appear until the Upper Pleistocene. That was about 40,000 years ago. Hominid (man-like) types appeared as early as one and a half million years ago. This earliest genus is called Australopithecus.

At one time students of human evolution sought a "missing link," a type of primate that would connect fossil primates with fossil man. A "missing link" was sought because it was believed that evolution went from a lower to a higher form in a straight line. We now know that evolution does not proceed in a straight line.

This chapter discusses only in a general way the fossil species. It does not discuss particular finds of the family Hominidae. They are discussed in order of age. The following discussion is arranged in the order in which features approach those of modern man. All of these fossil remains have been found in Africa, Asia, and Europe. None have been found in North and South America.

Australopithecines (See Chart and Illustrations pages 42-46)

The oldest known human-like forms were the Australopithecines. They lived in the late Pliocene and early Pleistocene, from 1,750,000 to 500,000 years ago.

Several types of remains have been found in South Africa and in East Africa. These indicate there were several species. The earliest species actually had features more like man than the later species. They had a brain from one-third to one-half that of modern man. Some stood about four feet; others, about five feet. They walked upright, probably with a shuffling gait. The skull was long and high, and the head was thrust forward. The jaws were large and heavy. They needed big jaw muscles to eat raw, coarse foods. Meat was included in their diet.

Some may have made a crude tool called a pebble tool. Tools are another sign that the Australopithecines were man-like. It is probable that they had language because they had tools.

Australopithecines are important in the record of fossil man. Their remains show that hominid types appeared earlier than was thought. They also show that Africa was important in the record of human evolution.

Homo erectus (See Chart and Illustrations on pages 42-46)

The species Homo erectus lived in the Middle Pleistocene, 500,000 to 200,000 years ago. Remains of several subspecies have been found in Java, Asia, Africa, and Europe.

The brain size of Peking Man was smaller than the average size for modern man. The brain was more specialized than in Australopithecus. This shows an increase in potential intelligence over Australopithecus.

Homo erectus stood erect, walked upright, and had a height somewhat over five, but less than six, feet. The skull was better balanced on the neck. This helped upright walking. He still had big teeth and strong neck muscles.

Homo erectus made better stone tools. A sub-species, Homo erectus pekinensis, is the first man known to have used fire.

Homo sapiens neanderthalensis (See pages 42-46)

Neanderthal Man is a sub-species of Homo sapiens that lived from about 200,000 to 80,000 years ago. This was during the time of the third interglacial and into the fourth glaciation. Like Homo erectus, he lived over a wide geographic area. Finds have been made in Europe, Asia, and West Africa.

The common idea of cave man is a heavy man with stooped shoulders. This idea is based on a reconstruction of a man who came from a place in France. More recent examination of his skeleton indicates that this idea is wrong. The skeleton shows he suffered a disease something like arthritis. His bent posture was not an inherited trait.

There are over one hundred Neanderthal remains from more than forty sites. There is good evidence to say what Neanderthal Man was like. He had a brain that averaged larger than modern man. The forebrain, however, was smaller. The skull was large, long, low, and relatively flat on top. He had heavy eyebrow ridges. The nose was broad and flat. He had no chin. The teeth were arranged like those in modern man, but the roots tended to come together.

The neck bones were shaped to give attachment to large neck muscles. Large muscles were needed to move the big skull. It is thought he may have had difficulty in moving his head. His bones were thick. The leg bones show that he usually rested in a squatting position. The outer edges of his feet supported most of his weight.

Homo sapiens spaelus (See pages 42-46)

This sub-species came before and lived at the same time as Neanderthal Man. He was a contemporary of Homo erectus. Even though he appeared earlier than Neanderthal Man, he had characteristics more like modern man. He had a smaller brain, a higher forehead, and less heavy brow ridges. Bone structure, however, was thicker and heavier than in modern man.

The Relationship of Neanderthal and Spaelus

At one time spaelus was called a "progressive Neanderthal." It was thought that he was an improvement over the regular Neanderthal type. The regular Neanderthal type was thought to have been an adaptation in Europe to the cold climate of the fourth glacial. Remains of Neanderthal Man of this regular type have been found in warm climates. It is now thought that Neanderthal Man as a sub-species disappeared in the Upper Paleolithic as a result of interbreeding with other types. He could have crossed with spaelus as well as *sapiens sapiens* types.

Homo sapiens sapiens (See page 42-46)

Modern man, whatever his race, belongs to a sub-species called *Homo sapiens sapiens*. He first appeared in the Upper Pleistocene during the latter part of the fourth glaciation. There were a variety of types in prehistoric times. Not all of them were just like contemporary man.

Cro-Magnon Man. The best known prehistoric type of this sub-species is Cro-Magnon Man. His brain case was larger than that of most modern men; he had moderate brow ridges. His general skull features are within the range found today. He was tall, his head was long, and his facial features were similar to those of modern Europeans.

The term Cro-Magnon is sometimes used to refer to our immediate ancestors. There is a diversity of types from different sites, however. Some features in these finds show Neanderthal traits; others had traits found in different modern races.

Fossil Remains and Modern Races

In the course of human evolution, many changes took place. Some of these resulted with populations in modern times having different racial features. The relationship of fossil remains to these differences is not known. One reason is that the fossil record depends only on skeletal remains. Most racial differences are non-skeletal differences, such as skin color, hair type, and eye color. On the basis of the skeletal remains, the oldest resemblances are in Europe. Here very late Pleistocene remains show resemblances to modern Europeans, particularly of a type called Mediterranean. It is not until the Holocene, or Modern Times, that a Negroid type is identified. This is in East Africa, in the cultural period called *Mesolithic*. This time began about 8,000 B. C. Clearly identifiable *Mongoloids* appeared later.

Human Change Continues

The process of human change continues. New races are emerging. One example is the Mestizo of Latin America. This is a result of the mixing of invader groups with the native Indians. The invader groups were mainly Mediterranean Caucasoid. North America is today populated by Caucasoids drawn from all the sub-races of Europe. Other people, both Negroid and Mongoloids, have also been added to the population. The changes in the human population will continue, especially where people of different types come into contact and cross.

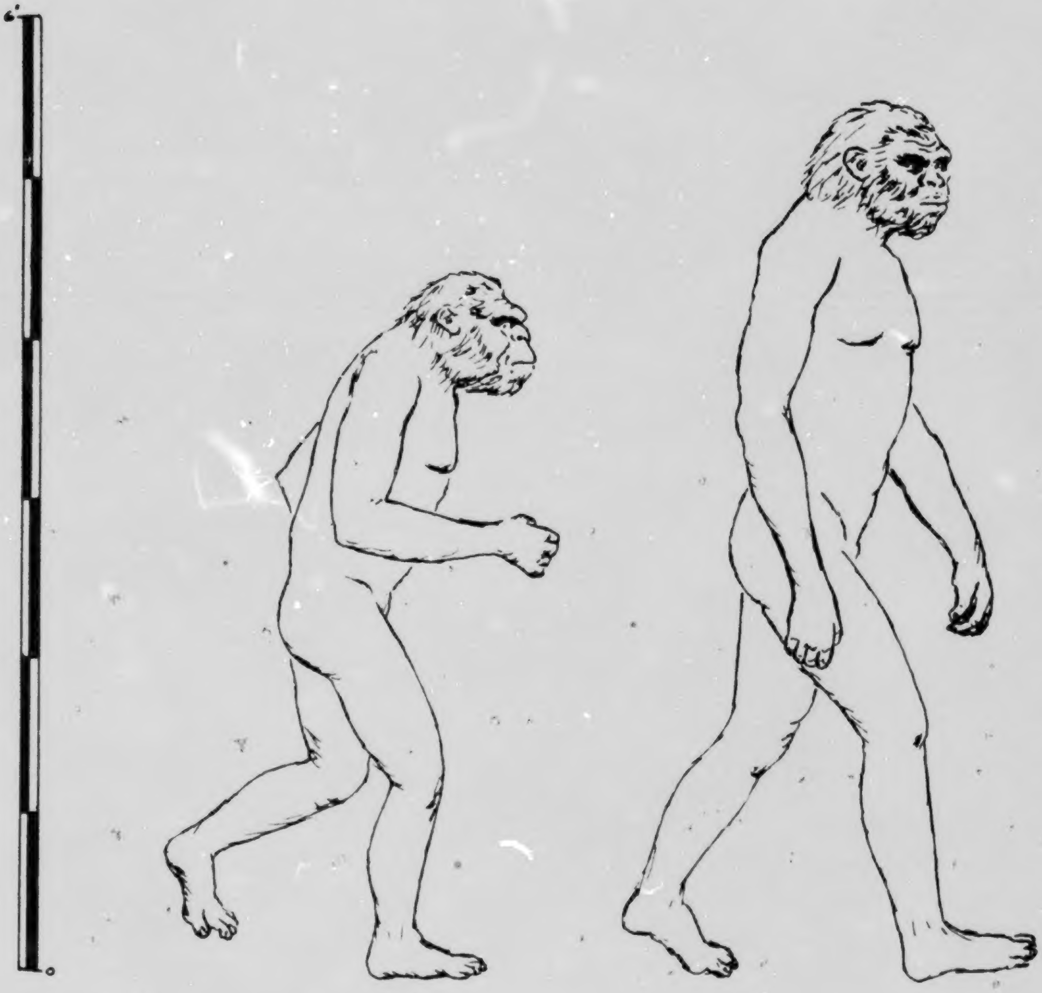
This chapter has given a brief summary of man's development from Australopithecus to Homo sapiens sapiens. The development of man, however, has been different from development in other animals. The big difference is that man had culture. The next chapter will describe how culture grew from the pebble tools of the Australopithecines to the urban civilizations of today.

CHARACTERISTICS OF

Classification	Years Ago	Cultural Stage
Homo sapiens sapiens	0-40,000	Upper Paleolithic to modern
Homo sapiens neanderthalensis	40,000- 190,000	Middle Paleolithic—Flaked stone tools, fire, burial of the dead.
Homo sapiens spaelus	40,000- 110,000	Lower Paleolithic into Middle Paleolithic
Homo erectus (Java & Peking)	190,000- 480,000	Lower Paleolithic—Peking Man is known to have made stone tools and used fire.
Australopithecus	1,000,000- 1,500,000	Lower Paleolithic—Possibly used or made pebble tools.

FOSSIL MEN

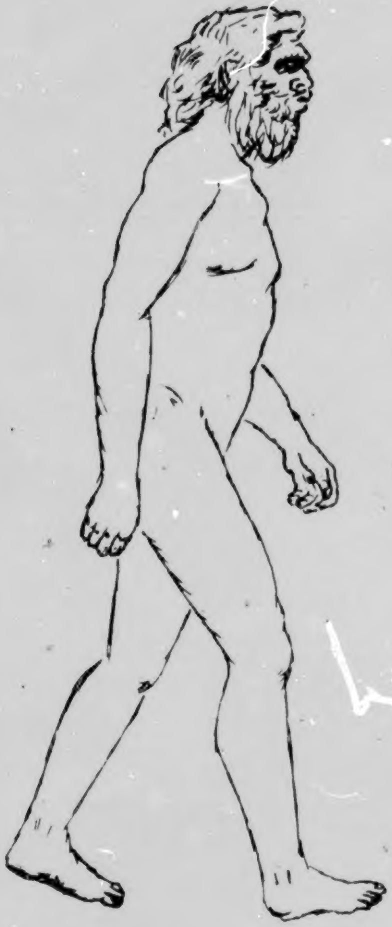
Posture	Feet and Legs	Hands	Teeth	Brain Size
Erect	Modern	Modern	Modern	Modern
Erect 5-6 feet	Short Robust	Short Robust	Larger than Modern	Slightly More than Modern
?	?	?	Near-Modern	Slightly less than Modern
Erect 5 to 5½ feet	Basically Modern	?	Larger than Modern	From ½ Modern to slightly less than Modern
Erect; not a good walker; 4 to 5 feet	Basically man-like feet and legs	Basically man-like	Very large back teeth; very small front teeth	From ⅓ Modern to ½ Modern



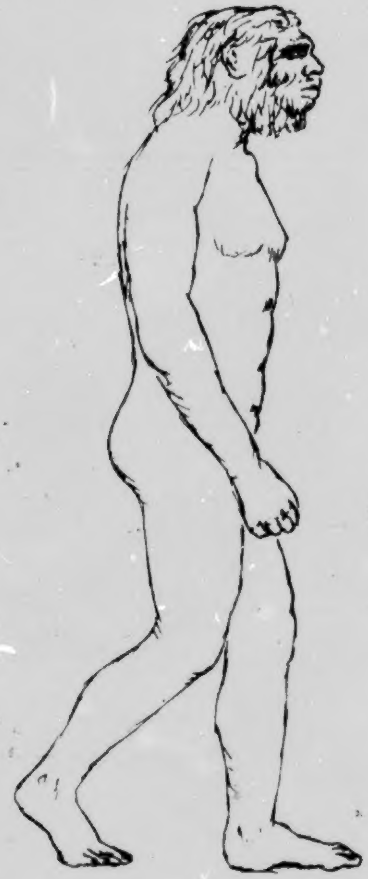
Australopithecus

Homo erectus

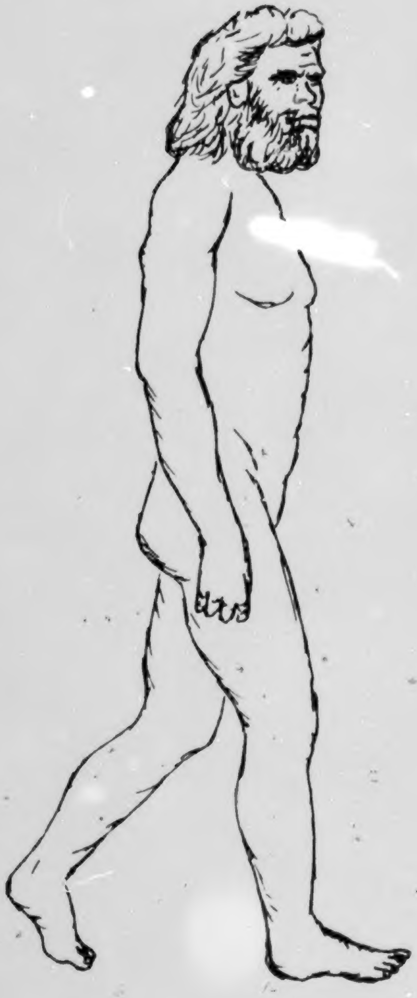
RECONSTRUCTIONS



Homo sapiens
spaelus



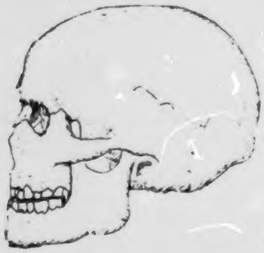
Homo sapiens
neanderthalensis



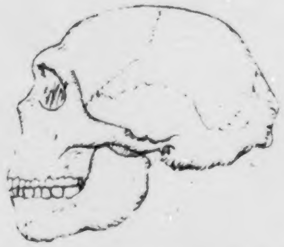
Homo sapiens
sapiens

OF FOSSIL MEN

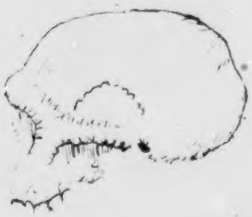
Fossil Skulls



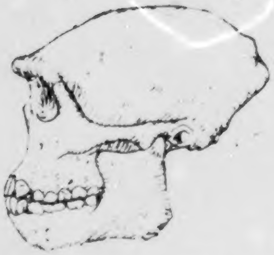
Homo sapiens sapiens



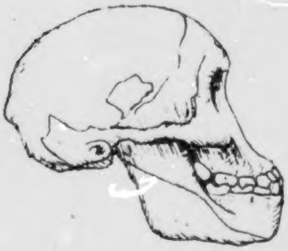
Homo sapiens neanderthalensis



Homo sapiens spaelus



Homo erectus



Australopithecus

OLD WORLD PREHISTORY

This is a chapter on the development of culture. It is based on archeological evidence. It is also based on conclusions archeologists have inferred from this evidence.

The Eastern hemisphere is called the Old World and the Western Hemisphere the New World. The Eastern Hemisphere is made up of Europe, Asia, Africa, and Australia. The Western Hemisphere is made up of North and South America.

The New World was not known to Europeans until the late fifteenth century. They found people already living in the Americas. Columbus called them Indians because he thought he had reached India.

The Indians, like the Europeans, were immigrants. Their ancestors had migrated to the Western Hemisphere in the late Pleistocene. They came into North America by the land bridge that once connected Siberia and Alaska. No fossil man has yet been found in the Western Hemisphere. From what we know today, the New World is new for man and culture.

The remains of many fossil men have been found in Africa, Asia, and Europe. It can truly be called the Old World: here man began. Here he began to make things and to create ways of living. Things and ways of living make up culture. Culture and man are always found together.

The prehistory of the Old World goes back into the early Pleistocene when man first began to use stone for tools. The Pleistocene is a million-year epoch. From it there are only a few clues of bone and stone to show how old man is.

Old World prehistory is rich in information; it is important because it shows how long it took man to develop his culture. Science and technology did not begin with the Industrial Revolution. It all began when the first man struck the first chips off a stone to make a tool thousands of years ago.

Tool Making and Tool Traditions

Tools. The chapter on fossil man showed how hard it is to really know about the first men. It is also hard to tell when culture began. This is because few things survive from those far-off days.

One thing archeologists do know about is tool making. Only man makes tools. Sometimes some animals use a piece of wood or stone. But tool making requires planning. And tools are usually made according to a pattern. A pattern is making things over and over again the same way by a plan. The finding of patterned toolmaking is a sign to archeologists that the fossil find represents man.

Tool traditions. The reason we know about these early tools is because they were made of stone. Stone does not rot or decay in the air or in the dirt. The only thing archeologists know about man in the earliest prehistory is from these stone tools. Archeologists therefore talk about a toolmaking tradition instead of about culture. Culture means more than tools.

An Overview of Old World Prehistory (See Chart on page 49)

During the geologic period called the Pleistocene man used chipped stone tools. This longest period of man's past is also called Paleolithic. "Paleo" is a prefix meaning "Old" and "lith" refers to stone. Paleolithic means Old Stone Age. This period is divided into Lower, Middle, and Upper Paleolithic periods. The Paleolithic lasted a million years or more.

We now live in the geologic period called the Holocene. It is the Modern Period. It began about 10,000 years ago. The first part of this period is called the Mesolithic. "Meso" means "middle." Mesolithic must not be confused with Middle Paleolithic. Mesolithic is the period between the last of the Paleolithic and the beginning of another period called Neolithic. "Neo" means "new."

CHRONOLOGY FOR OLD WORLD PREHISTORY

Years Ago		Geological Chronology	Fossil Men	Cultural Chronology			
1,400 B.C.	HOLOCENE	Modern Times	↑	Iron Age	Iron Tools	Urban Societies	
3,000 B.C.				Bronze Age	Bronze Tools		
				Neolithic	Polished stone tools	Neolithic Cultures Food production replaces hunting and gathering	
6,000 B.C.							
				Mesolithic	Microliths	Mesolithic Cultures Man spreads throughout the world	
8,000 B.C.	UPPER PLEISTOCENE	4th Glaciation	*Homo sapiens sapiens*	Upper Paleolithic	Blade tools ↑	↑ Upper Paleolithic Cultures	
			Homo sapiens neanderthalensis	Middle Paleolithic		Mousterian Culture	
40,000 B.C.							
		3rd Interglacial	*Homo sapiens spaelus*	Lower Paleolithic			
190,000 B.C.	MIDDLE PLEISTOCENE	3rd Glaciation				Levalloisian	
		2nd Interglacial			Acheulean		
480,000 B.C.	LOWER PLEISTOCENE	2nd Glaciation	*Homo erectus pekinensis*			Clactonian	Chopper Tools (Asia)
		1st Interglacial	*Homo erectus erectus*		Abbevillean		
		1st Glaciation	*Australopithecus*		Oldowan Pebble Tool (Africa)		
one million or more yrs. B.C.			↓		CORE TOOL TRADITIONS	FLAKE TOOL TRADITIONS	

NOTE: Vertical dimension is not to scale

In the Mesolithic man found out how to use small sharp pieces of stone set in wood. These are called "microliths." "Micro" means "little."

The Neolithic started about 6,000 years ago. Man began to use polished stones. The polished stones took a lot of work. But the really important invention of this time was agriculture. Now man could grow his own plants and raise his own animals for food. He no longer had to gather wild plants and hunt game.

Culture change became more rapid. In only 3,000 more years man learned how to make tools of copper, and then to add tin to copper to make bronze. This is called the Bronze Age. And in another 1500 years he learned to make iron tools. This is the Iron Age. We are still living in it. Our modern industrial economy depends on iron.

There were other important cultural developments in the Bronze and Iron Ages than metals for toolmaking. Man learned to live in villages; then in cities. He established city-states. He began to manufacture. He increased his trade. It is merely convenient to call these later periods by the metal used in making tools.

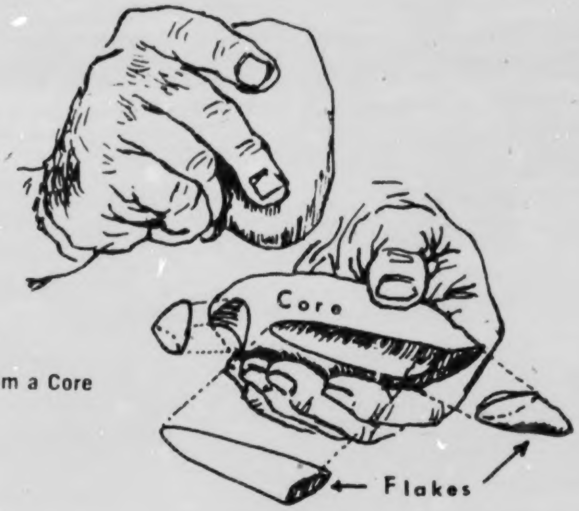
Now study the chart "Chronology for Old World Prehistory" on page 49. Chronology refers to time. Start at the bottom left, read across to the right, then back to the left, etc. This chart will help you keep in mind how the various parts of Old World Prehistory fit together. Also refer to the illustrations on pages 76-77 of the various tools which are described in the following sections, and the Summary of Old World Prehistory on pages 74-75.

The Lower Paleolithic

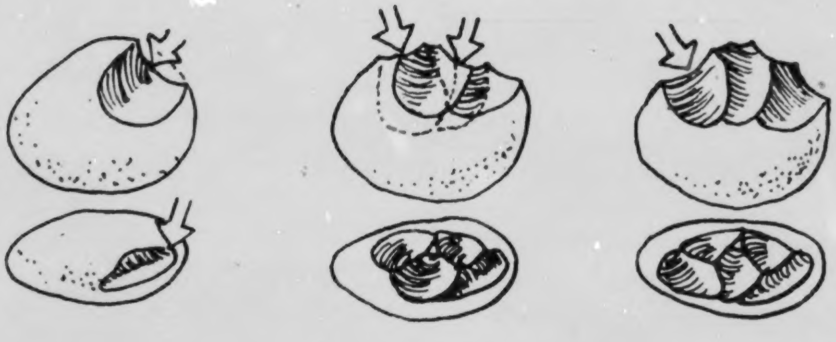
This section will discuss two toolmaking traditions. It will also discuss how archeologists think man lived in the Lower Paleolithic.

Toolmaking traditions. Core and flake tools are the two basic types. They were made in the same way. A stone was hit with another stone or club. The blow knocked a flake from the first stone. The removal of such flakes left a core. This is called a core tool. The sharp flake that was knocked off the core could also be used as a tool. This is one kind of flake tool.

Making Core and Flake Tools



Method of Removing Flakes from a Core



Removing Flakes from a Core to Make a Pebble Tool

Core tools. Three kinds of core tools are pebble, hand axe, and chopper. All of these types were held in the hand. The one called a hand axe is a pointed, pear shaped tool. The one that looks like an axe blade is called a chopper.

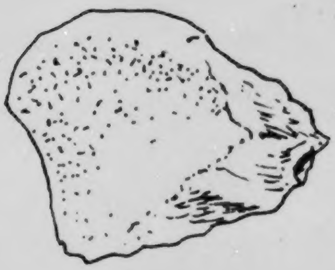
The earliest kind of core tool is called a pebble tool. Pebbles have been found with fossils of Australopithecines. At Olduvai Gorge in Tanzania, Africa, pebble tools are found in a stratified sequence. The upper strata show improvements. It would appear that man's first toolmaking took place in Africa.

A pebble in the archeological sense does not refer to gravel. It means a smooth stone of fairly good size. Thus, pebble tools could fit in the hand. The pebble tool was made by knocking a few flakes from one end. This left a broad, sharp edge that could be used for cutting, scraping, or chopping.

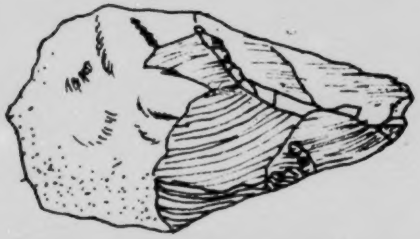
As time went on, pebble tools were chipped all around. They soon became pear-shaped with a sharp edge all around. This represents the beginning of the hand axe tradition (Abbevillian). (See Illustration on page 76)

The hand axe was an all-purpose tool. It was not mounted on a handle, but held in the hand. As time went on, the hand axe was improved. Smaller and shallower flakes were removed, making a smaller tool with a more even cutting edge (Acheulian). It was the main tool in Africa and Europe for several hundred thousand years. (See page 76)

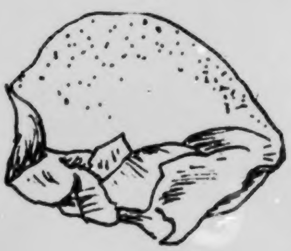
In Eastern Asia, the early pebble tool developed into a tool called a chopper. It was also a core tool held in the



Pebble Tool



Hand Axe



Chopper

hand. It differed from the pointed hand axe of Europe and Africa. It had a broad edge like a modern axe.

Flake tools. The earliest flake tools were the by-products of core tools. Some early people used flakes more than core tools, and thus had a different tool pattern (Clactonian). (See Illustration on page 76)

Toward the end of the Lower Paleolithic, a new way of chipping flakes developed. This involved shaping a piece of stone to resemble a very large hand axe. Then a large flat flake, like a thin hand axe, could be struck off. This flake required little or no finishing. It had a sharp edge good for skinning (Levalloisian technique) (See page 76).

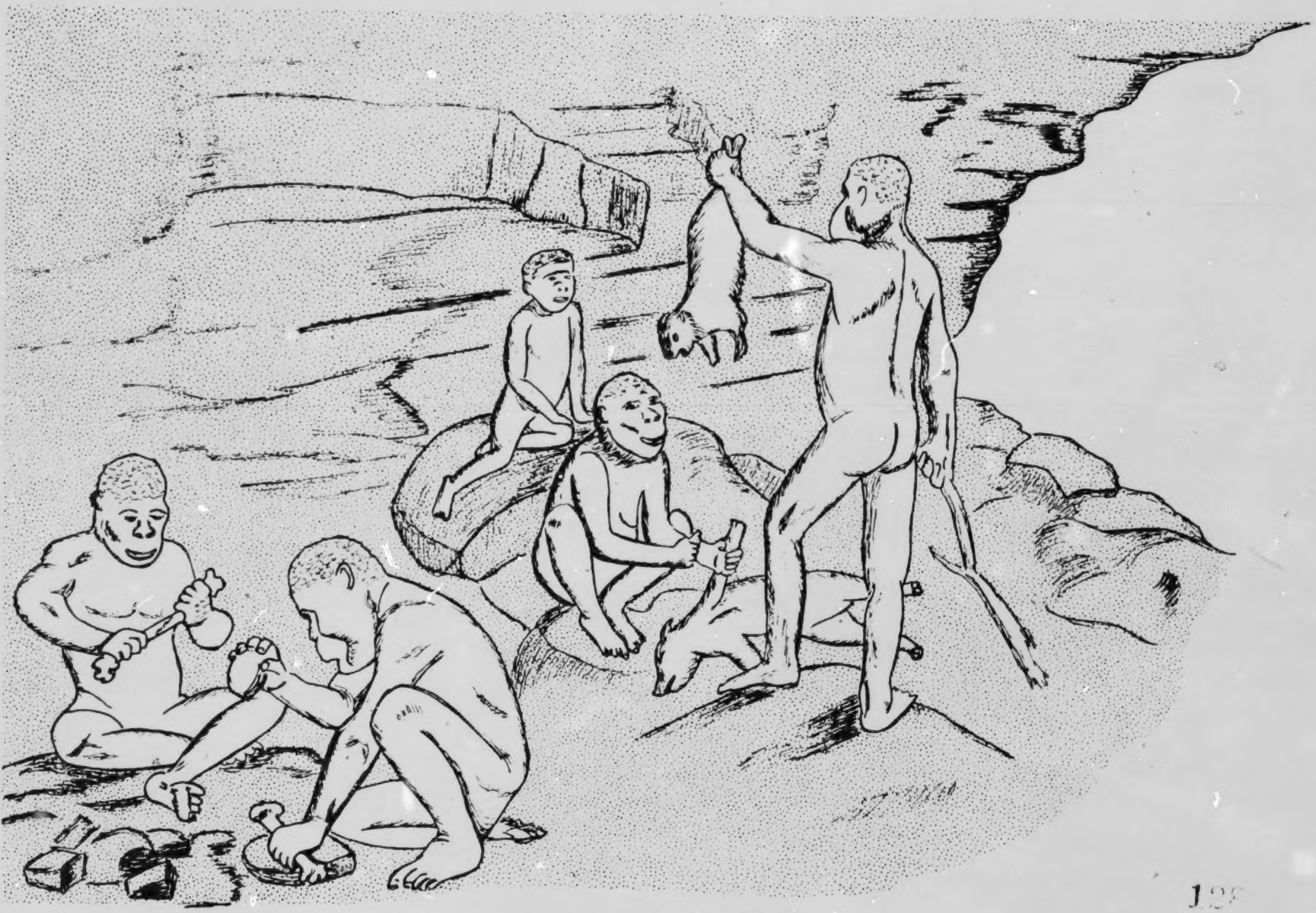
Flake tools were used more and more. But in the Lower Paleolithic, both core and flake tools were used. Some people, however, used one more than the other.

Now refer carefully to the time chart on page 49. The Oldowan Pebble Tool tradition could have lasted as long as a million years with little or no improvement. Hand axes were used for five hundred thousand years or more. There was very little change in man's tool-making capacity for over a million years. But man had started down the road of culture. He had learned to make something. He had learned to make a stone sharp and pointed.

Culture in the Lower Paleolithic

It is hard to reconstruct man's way of life in the Lower Paleolithic. This is the longest period of man's history. The archeological record is also the poorest. But there is enough evidence to describe in a general way how man lived at that time. During this period there were two different fossil men: Australopithecus and Homo erectus.

Australopithecus. He lived in bushy country on the edge of the forests. The climate was warm and mild and whether he made use of shelter is not known. He probably lived, as all hunters do, in small groups.



Culture of Australopithecus in the Lower Pleistocene

Some species are thought to have lived primarily on vegetation while others also ate meat. The first species probably could only catch and kill small or young animals. As time went on, they successfully caught larger animals. Better success at hunting is shown by the remains of very large animals. These animals were so big that men must have helped each other. Helping each other in hunting is an indication of social development.

At first, Australopithecus merely *used* natural objects, such as stone and sticks, as tools. Only later did they begin *making* pebble tools.

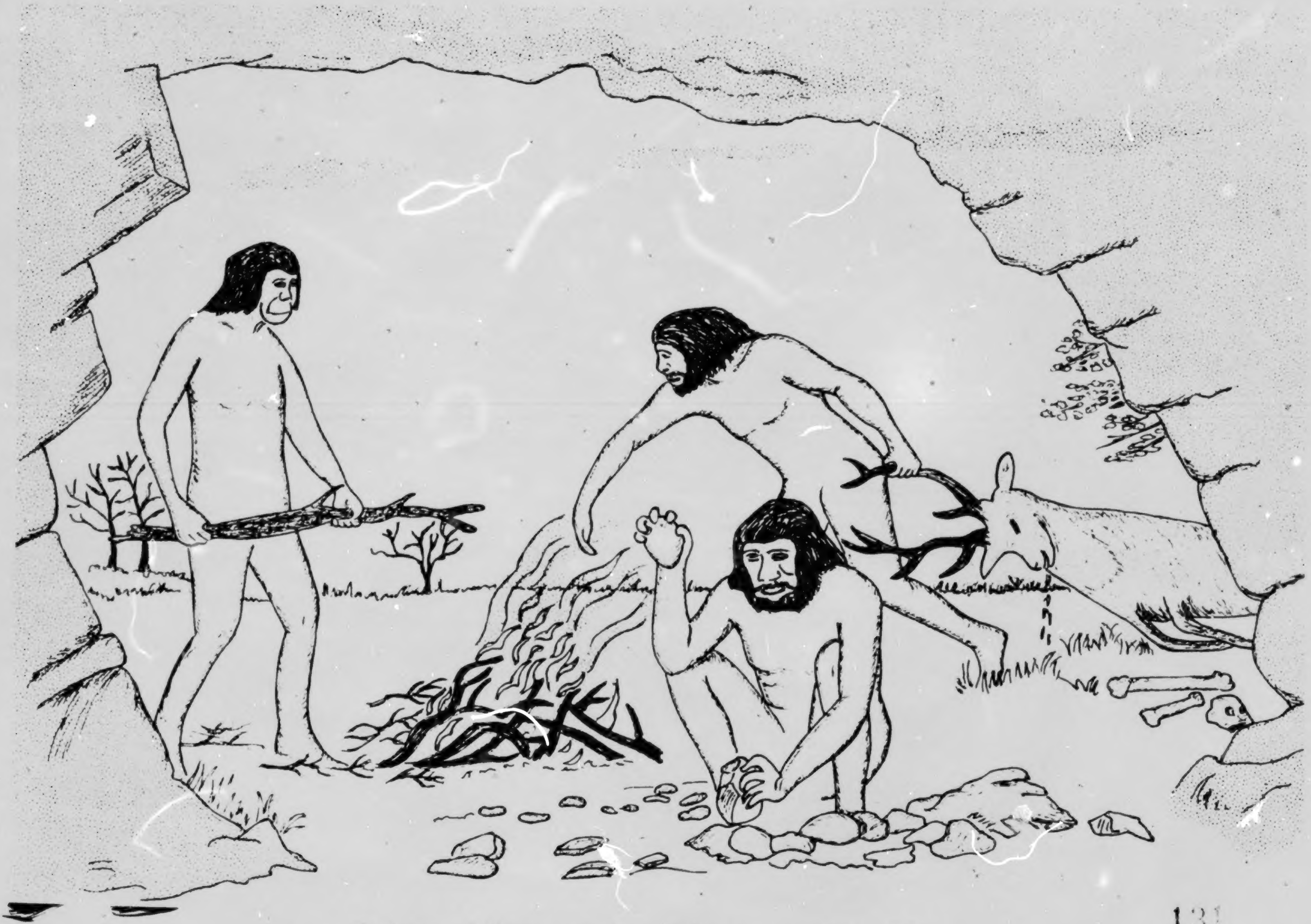
Homo erectus. The best remains of the culture of this type come from a cave near Peking, China. This is the culture of *Homo erectus pekinensis* (Peking Man) who lived about 500,000 years ago. His culture is contemporary with the hand axe tradition of Africa and Europe.

Peking Man lived in a cave. His artifacts and fossil remains are relatively well preserved. He is the earliest man known to have used fire. Fire would have kept him warm, cooked his food, and frightened away wild animals.

His basic tool was the chopper. Many that were found are so crude that they would not alone be recognized as tools. They were found, however, with fossil remains and other evidence of human habitation.

Tools were made of quartz. They were probably brought to the cave from a quarry site about five miles away. This indicates he was in search for the best materials from which to make tools. Quartz is one of the hardest of all minerals.

Peking Man probably used a pointed, fire-hardened spear made of wood as a weapon. No remains of such a spear have been found, nor is it likely that any will be found. Wooden objects do not last that long, unless mineralized. He must have used such a spear because he was a successful hunter. The evidence from later sites shows that a wooden spear was one of the earliest weapons made by man. To kill large



Culture of Homo erectus in the Lower Paleolithic animals he would have had to use something better than the hand "chopper" axe. African pygmies of today kill elephants with fire-hardened wooden spears.

Animal remains near Peking show he ate lots of deer. He also killed such big animals as mammoths and such fierce animals as bears and saber-toothed cats. He used pit-traps to trap game. A pit-trap is a hole dug in the ground and covered with a thin layer of brush and grass.

He also probably ate large amounts of wild seeds and berries. The seeds of a kind of wild cherry were found in the cave site. Evidence of other plant food would have decayed. The way some of Peking Man's bones were broken shows that on occasion he must have been a cannibal.

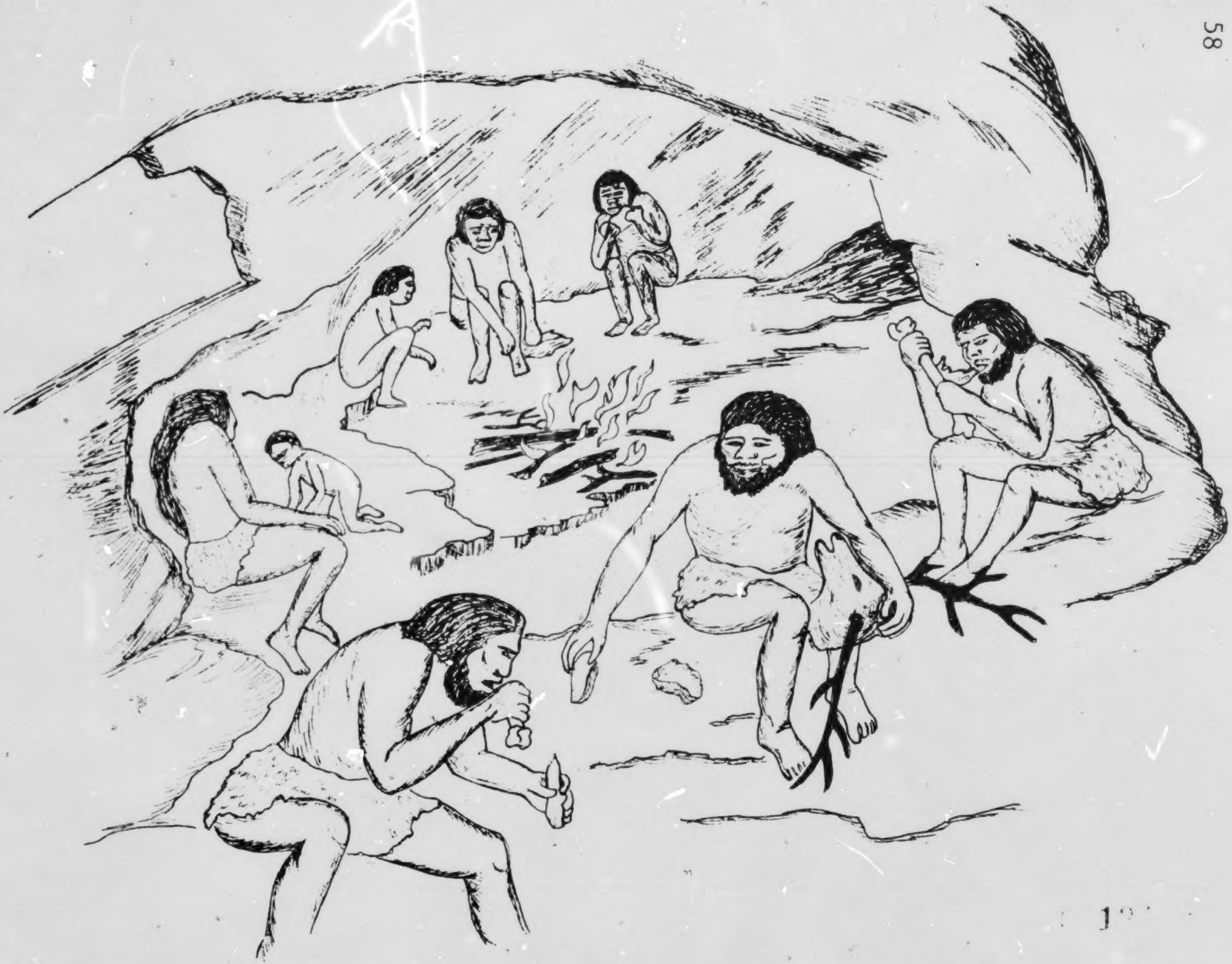
At Peking no evidence of burials was found. In the absence of evidence of burials or other rituals, it is impossible to say if Lower Paleolithic man had or did not have such practices.

The size of the group that lived at Peking is not known. Only small groups of hunters can live together. This is because large groups cannot find sufficient food in one place. The group was therefore small and probably based on kinship, as are most hunting and gathering groups. Peking Man would have had to work together to kill such big animals with such poor weapons. It is therefore believed that he had developed some degree of social cooperation.

It is thought that the way of life of other Lower Paleolithic men was similar to that of Peking Man. Some may not have had fire. There was some improvement in core and flake tools in the Lower Paleolithic, but these were not enough to bring about important changes in the way he lived.

Middle Paleolithic Culture

In Europe, this is the culture of Homo sapiens neanderthalensis (Neanderthal Man). He lived in the early part of the fourth glaciation. This was some 40,000 years ago.



133 Culture of Homo sapiens neanderthalensis in the Middle Paleolithic

Although this is fairly recent on the time scale of prehistory, Neanderthal Man did not have much better stone tools than Peking Man had. He did not appear to have better ways and methods of hunting.

This period saw two accomplishments, however. The first was an extension of human settlement north. How Neanderthal Man was able to do this during such cold weather is not known. He lived in caves, whenever possible, and used fire. He also probably wore some kind of cloak made out of animal skins. This is inferred from the many flint scrapers found at habitation sites. Scrapers would have been used to scrape and clean animal skins.

The second accomplishment of Neanderthal Man was the first known burial of the dead. These burials were probably accompanied by some kind of burial rite. This is indicated by food and other objects in the burials. He may have also developed some kind of hunting ritual. This is indicated by bear skulls arranged in a special order. From these it is inferred that Neanderthal Man had developed ideas in advance of his material culture. His material culture had only slightly improved over the Lower Paleolithic.

Upper Paleolithic Cultures

Cultures of the Upper Paleolithic developed during the last part of the fourth glaciation. The weather was still very cold. But several important changes took place. Man of the modern type, Homo sapiens sapiens, appeared.

Men also developed a greater variety of tools. Among these was the bone needle which made fitted clothes possible. He also developed painting and elaborate burials. These suggest that better ways of hunting gave him more leisure time.

This discussion of the Upper Paleolithic is based on sites found in Europe. In Africa and in Asia, improved Lower Paleolithic tool making methods continued until modern times. There was no parallel development of the European blade tools in these areas. This meant, of course, that the tools used in these areas were not as efficient as those used in European areas.

Tools and weapons. A blade method of working stone was developed. It involved the use of bone to work stone. First a core was made with a flat top and straight sides. Then a bone punch was held near the edge. The punch was hit with a hard blow with a club or stone. The force of the blow split off a long stone flake or blade. Many blades could be struck off, one after another, until almost nothing was left of the core. A small amount of stone could produce many blades.

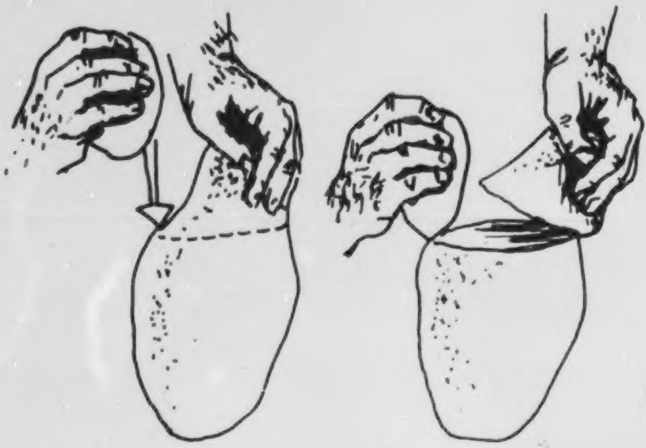
Pressure flaking was then used to shape the blades. Pressure flaking was done by pressing down very hard on the edge of the blade with a bone tool. The pressure flaked off very tiny chips. This gave a more evenly shaped tool than the old method of knocking off chips with a piece of wood or stone. Different kinds of tools were shaped this way from the basic blade. Among them were scrapers for shaping the wooden spears and for cleaning skins, awls for drilling holes in wood or bone, and burins.

The burin is a small stone chisel. It is a tool to make other tools. For the first time, man had a tool with which he could shape horn and bone. From horn and bone, he could make harpoon heads to fit to the ends of his spears. Points of bone or horn do not blunt as easily as wooden points; are not as brittle as flint, and do not break when they strike bone.

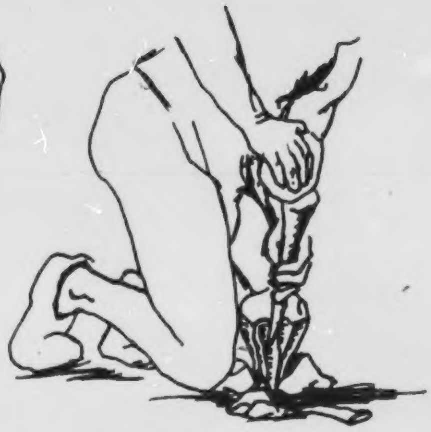
With burins he made needles from bone or horn. The needle is an important tool. Fitted clothing requires some sewing and sewing requires a needle. Upper Paleolithic man's fitted clothing made from animal skins enabled him to live better in the cold climate.

The spear thrower was an invention which helped in hunting. The spear thrower is an extension of the thrower's arm. With it he can throw a spear with greater force. The spear thrower is made from a piece of wood or bone about two

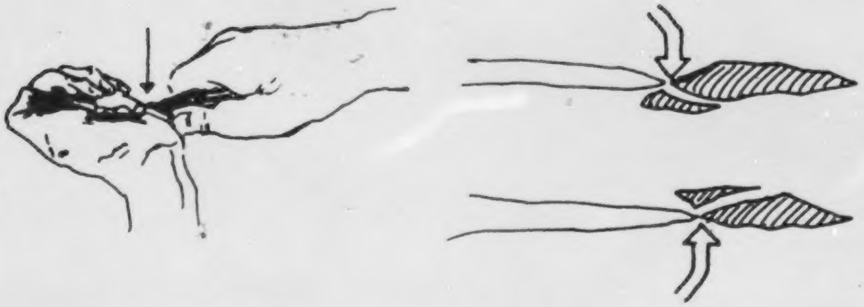
MAKING BLADE TOOLS



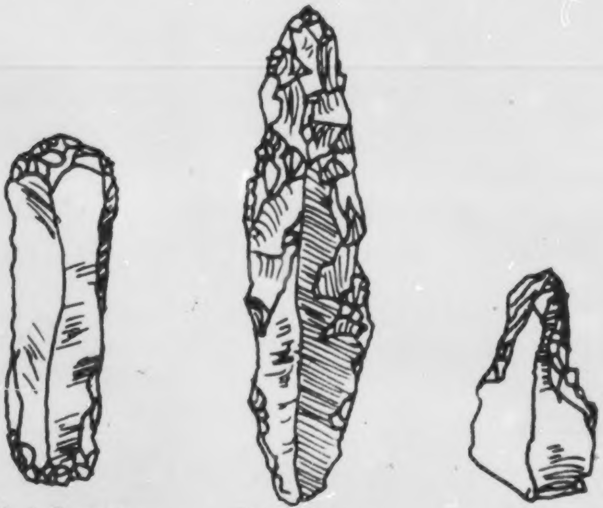
Preparing a Core before splitting off Blades



Splitting off Stone Blades with a Bone Punch



Removing Tiny Chips from Stone Blades by Pressure Flaking



End Scraper

Spear Point

Burin

FINISHED STONE BLADE TOOLS

feet long. One end is notched to fit the hunter's hand. The other end is hollowed out to hold the end of the spear.

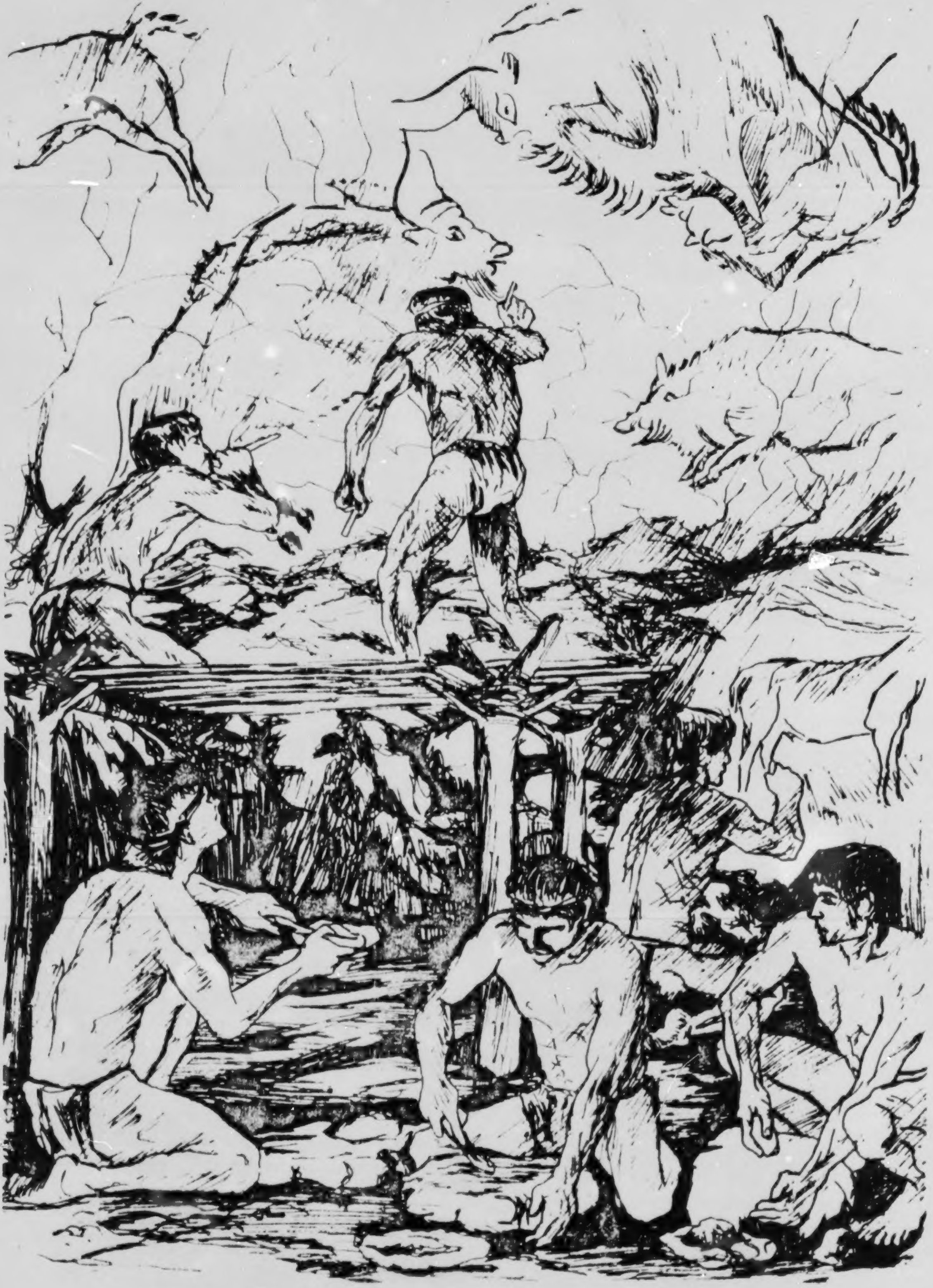
Life in the Upper Paleolithic

Hunting was still the main way of living. But now man had improved weapons and did not have to spend as much time on the hunt. While he still did most of his hunting by stalking, he also used nets, traps, and animal drives.

In the animal drives, groups of hunters organized to hunt together. They spread out where game was plentiful. With noise and fire they would close in on the animals and drive them into a natural corral or over a cliff. Then the animals would be killed, skinned, and cut up for meat. The remains of these drives indicate that they were usually held in the fall. It took several groups of hunters to organize and carry out such animal drives. By this time man had developed social cooperation involving more than one group.

The basic social group, as in former times, was still a small band of hunters. It was probably organized like a large family. The group lived in a cave part of the year and at other times in shelters made of animal skin. In areas where there were no caves they dug out holes in the ground and covered them with a roof. In the fall, bands would gather for a short time for an animal drive. After the drive was over, each band returned to its own area for the winter.

Art and rituals were developed. There were two types of art--tool decoration and cave painting. Many objects made for daily use were painstakingly carved. More impressive are the paintings. These are often found in deep caverns which are hard to reach. It is therefore thought that they were not mere ornamentation. They were probably part of hunting rituals to bring good hunting. Fertility rituals were used to bring about birth. Man did not live long at this time. Life was hard and short. Rituals to replenish the strength of the band could have been important.



Culture of Homo sapiens sapiens in the Upper Paleolithic

There were also *burials*. Like Neanderthal Man, Upper Paleolithic men were concerned about life and death. The corpse was buried or covered with a pile of stones. Food and weapons were provided for the after life.

There was a general improvement in life during the Upper Paleolithic. Men did not have to spend as much time hunting. Only people who have a fair food supply can spend time doing things that do not produce food. The art and ritual of the Upper Paleolithic are evidence of an improved technology.

End of the Pleistocene

The Pleistocene period faded with the last retreat of the great glaciers. The climate grew warmer. Plant life changed and forests began growing farther north. The larger animals, such as the mammoth, died out. The reindeer, the principal diet of Upper Paleolithic man, moved northward. Smaller game animals of modern times appeared. With these changes, the climate, flora, and fauna of the northern hemisphere became much like it is today. This marks the beginning of the Holocene, or Modern, Epoch. The first new culture of this epoch was the Mesolithic, a vastly improved hunting culture.

Mesolithic Culture

The Mesolithic period lasted about three thousand years. It was a time of rapid technological improvement. *Microliths* came into general use. Microliths were small sharp stones set in the handle or shaft of a tool. The *stone axe* with a broad cutting edge mounted on a handle was invented. It was a true axe, unlike the hand-held, pointed "hand axe" of the Lower Paleolithic. With this axe man was able to use wood. The bow and arrow came into general use, with a microlith as the arrow point. Boats were developed. Shell fish became an important food source. The true fish hook made line fishing possible. Fish were still taken by spearing, but nets, traps, and hook and line greatly increased the importance of fish in the food supply. The dog also became man's hunting companion. Mesolithic man also spread into all parts of the world.

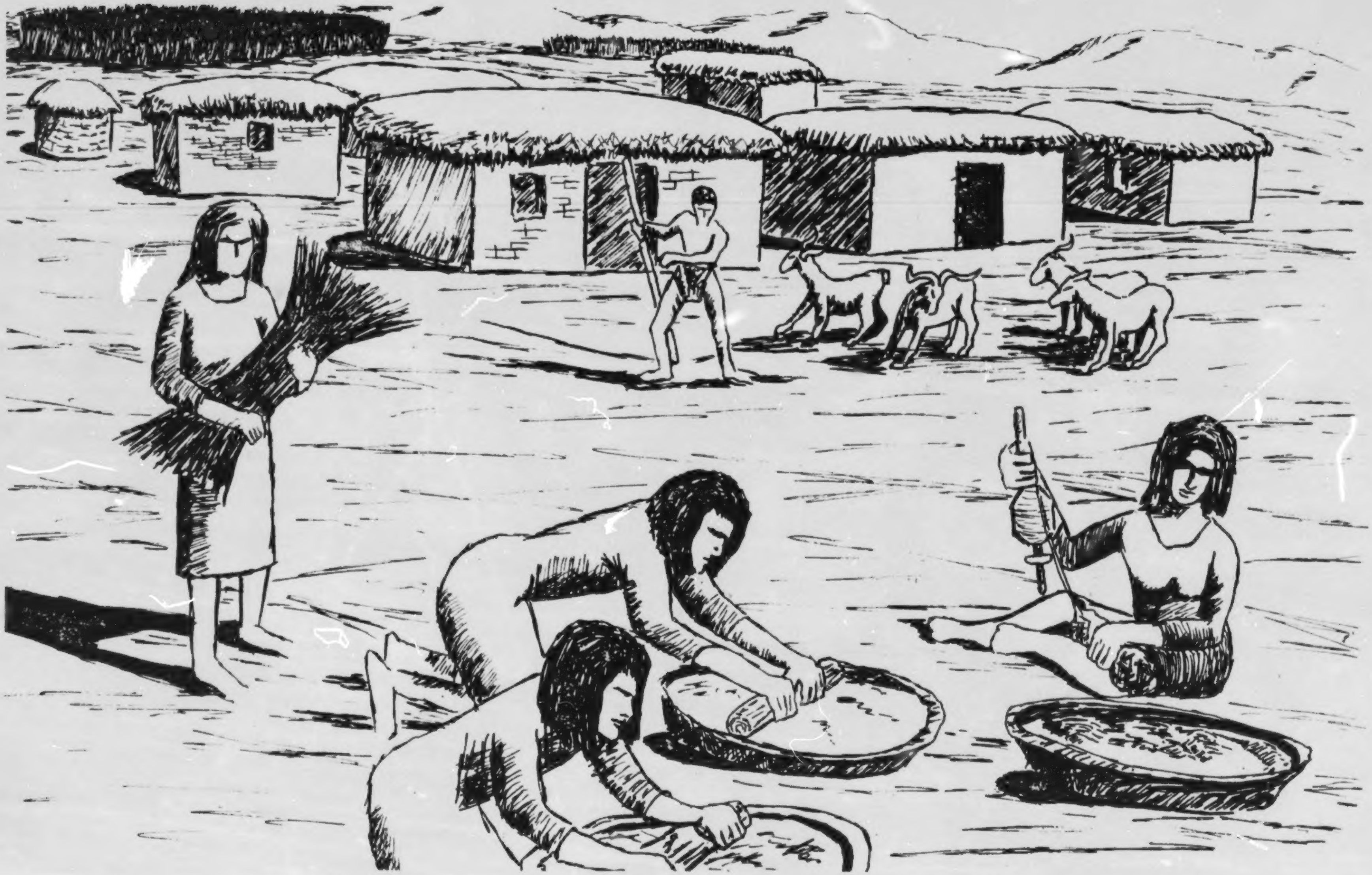
Artistically, however, there was a decline. There was almost no continuation of the decoration and painting found in the Upper Paleolithic.

Neolithic Revolution

Limitations of a hunting and gathering economy. The hunting and gathering type of economy can only support small groups of people. This is because an area can carry only a limited amount of animal life. As the animals move, or the supply is killed off, man has to move. As a result, hunters seldom live in permanent settlements. Their culture is limited. So much time is used in getting food that little time is available for other activities. Moreover, not many things can be carried on a move to a new campsite. Frequent moves discourage having many things.

It was not until man became a food producer that there was a sharp change in man's cultural development. Food production made it possible for man to settle down. It also made it possible for him to live in larger groups. Large groups were basic to the development of civilizations. The change to planting and animal raising is perhaps the most important development in man's history. The change from food gathering to food production came about in the Near East. The time was between 7,000 and 6,000 B. C. Food production, not the use of polished stone tools, was the real Neolithic Revolution.

Gradual development of food production. Domestication of plants was very gradual, and is related to climate changes. As the Pleistocene ended, the weather in Africa and the Middle East became drier. Wild grain, adapted to the more arid climate, appeared. It is likely that hunters began to depend more and more on wild grain for food. They learned to use it, help it grow, and finally planted it. At the same time, they were learning to domesticate animals. Just how or when this came about is not known. The earliest domestication of plants probably took place in the southern



Culture of Homo sapiens sapiens in the Neolithic hills of Turkey and near the Caspian Sea. The American Indians independently domesticated plants at a later date than in the Near East. There was probably an independent domestication of plants in Asia.

Jericho and Jarmo. Several Neolithic sites have been excavated in the Near East. These sites show stages in the development of agriculture. One of these is at Jericho, now in Jordan. Its history goes back to 7800 B. C., well before the city of Biblical fame was built. Here a small group of hunter-fishermen lived around a spring. They grew grain which they harvested with a reaping knife. The reaping knife had a cutting edge made of microliths.

Later strata show progress toward a settled way of life. There was a gradual domestication of cereals and goats. The settlement grew in size. Houses were built of mud brick and a protective wall was put around the village.

Jarmo is a site in northern Iran. Its story is similar to that of Jericho. The people gradually changed from Mesolithic hunters to Neolithic food producers. In the upper strata, bone remains show that only five per cent of the animals that were eaten were wild. They had goats, sheep, cattle, and pigs. Pestles, mortars, and milling stones indicate the importance of grains. Microliths and polished stone axes indicate transition from Mesolithic to Neolithic tools.

Village development. Food production brought about the development of villages. A herd of animals and a storehouse of grain brought about a feeling of security. A man could now afford to build a house and stay in one place. And the same area could support more people. Men could live in much larger groups.

Village life also brought about two important inventions. One was pottery making and the other was the weaving of cloth. Pottery making added greatly to the supply of utensils. The weaving of cloth made possible a greater variety of clothing.

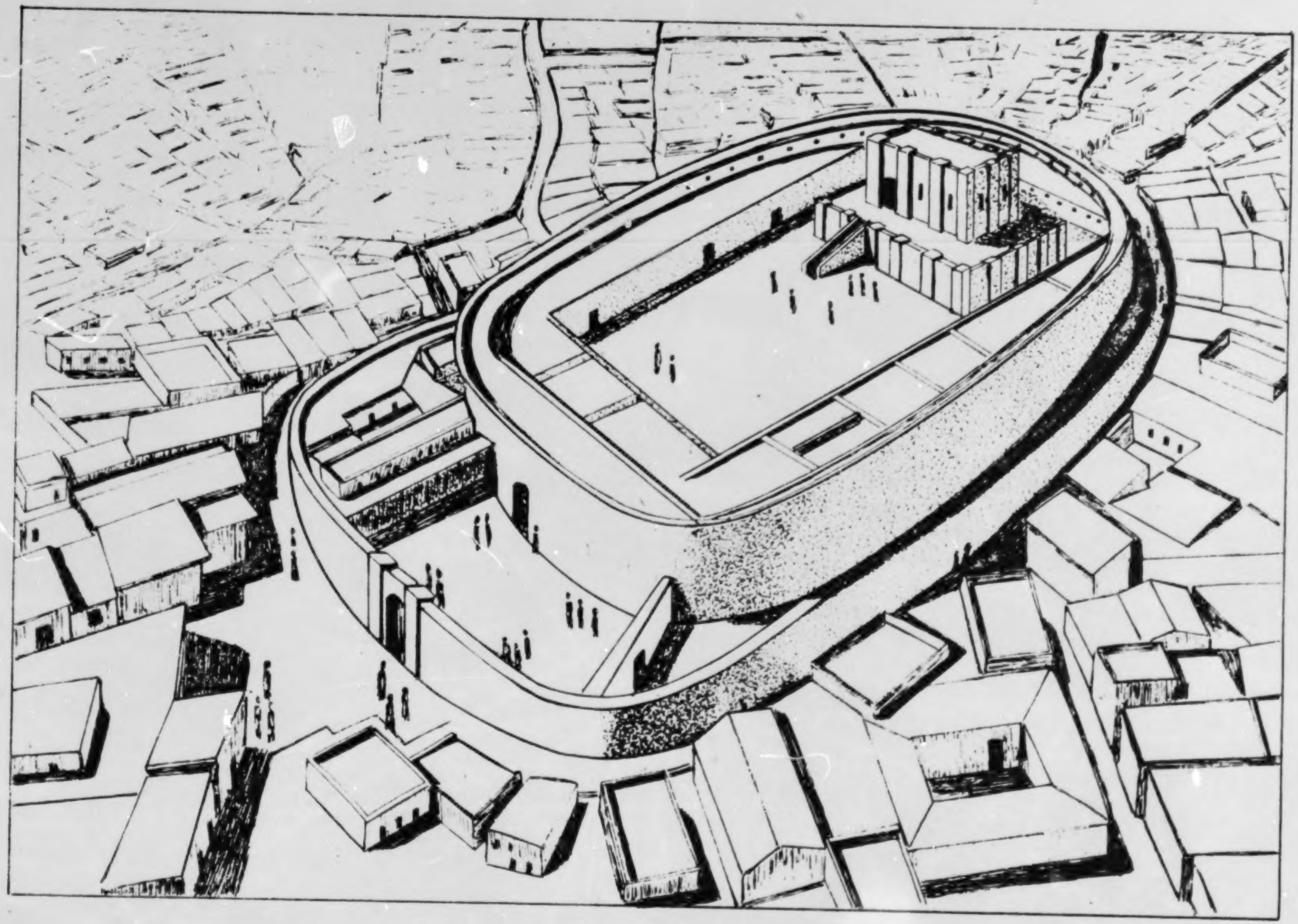
By 6,000 B. C., villages were widespread in the Near East. Most were small, with only a few houses. The houses were built of mud walls on a rock foundation. They usually had only two or three small rooms. Each probably housed a family.

These early Neolithic villages were similar to the modest villages of peasant farmers that are found in many parts of the world today. There was little craft specialization, except for pottery making. There were no specialized structures, such as temples. Most of the people did the same tasks, working in the fields and caring for the animals. Early ritualistic practices probably were fertility rites to bring about good crops and an increase in the herds. These early farmers were important in three ways. They lived together in a permanent settlement, stored food, and required some specialized skills. These villages laid the foundations for urban society.

The Urban Revolution in the Bronze Age

Cities developed in the Near East between 6,000 and 3,000 B. C. A city was not just a big village with more people. It had a different way of life. This came about from trade and the specialization of labor. In a farming village most people lived and worked in the same way. A city had to be fed from the countryside. This required transportation and a system of trade. A city required many different kinds of skills, and craftsmen of all kinds developed. Trading brought about a movement of people and an exchange of ideas. Inventions increased. City growth in turn brought about the need for more authority. Rulers, priests, and soldiers appeared. Trading needs stimulated the invention of writing to keep better records. Writing in turn increased the growth and spread of knowledge. Cities brought civilization.

City growth, like farming, developed over a long period of time. There were four developments important to the rise of literate urban societies. These were: more agricultural production, labor specialization, trade, and growth of the ruling authority.



An Early City in the Near East

More food production. A city of non-farmers requires a large food surplus. Two developments occurred about 5,000 B. C. which brought about more food. Farmers moved from the hills of northern Iraq to the rich soil of the Tigris-Euphrates Valley. They learned to irrigate the soil and to harness cattle for plowing. They could now produce great surpluses of food needed to support the non-farming city population.

Specialization. Craft specialization, beginning in the farming village, grew. Full-time work at a craft led to a high level of skill and improvement in the product. Production in large quantities was made to fill expected and not immediate orders. A large number of workers could now be fed on public works projects.

Trade. The cost of bringing stone and wood into river valley cities was met by the food surplus. Sailboat transportation had been introduced in the eastern Mediterranean by 3,000 B. C. Wheeled carts appeared in Sumeria about 3500 B. C. Improved water and land transportation made trade easier. The wheel was applied to the making of pottery and irrigation.

Central authority. The direction of public works and regulation of trade required the development of a central authority. At first this was exercised by the local temple priests. The temple, with its priestly ruling class, was a mark of the early river valley cities. As time passed, temples and larger stepped temples called ziggurats were built.

Bronze technology and cultural development. The invention of the alloy bronze for tool making stimulated trade. Copper was used by some Neolithic village people to make tools. But copper was too soft to make a good tool. The addition of tin to copper made a strong alloy. Copper ore and tin ore are not found in the same place. The ore had to be smelted. The copper and tin was then brought to a central place where the bronze alloy and tools were made.

The development of this kind of bronze technology shows how many factors of cultural development work together. The agricultural surpluses made trade possible. There was further specialization of labor. A political unit is needed to protect trade routes and to regulate the population. An urban or city society develops.

Bronze technology was just one of the developments of the period. The important thing was the development of the urban societies. Just as the Neolithic was really the period of the agricultural revolution, the Bronze period was the time of the urban revolution. By 3,000 B. C., complex urban life had emerged. Writing had developed. Historical time, the period with writing, had begun. Archeologists have additional information beginning with this period because of the written records.

The spread of urban life. Innovations of the Neolithic and Bronze Age gradually spread into Africa, Asia, and Europe. The pace was very uneven. Even today, except for the use of iron tools, the way of life of millions of people is still more like village farming of the Neolithic than of the urban Bronze Age.

Egypt is a good example of the development of urban life. It began somewhat later than in the Tigris-Euphrates Valleys. It followed the same development. First hunters and gatherers became farmers and village dwellers. Some of the villages became trading centers and later large cities with centralized political control. Life in Mesopotamia and in Egypt were similar in many respects. Both were based on village farming. A broad difference was that Mesopotamia was more interested in trade and was less isolated than was Egypt. Egypt was a religion-oriented society. Archeologists know so much about Egyptian society because so many things were preserved with the dead.

The Alphabet and the Iron Age

About 1400 B. C. iron working began. Iron working was not associated with as important changes as took place in the

Neolithic or the Bronze Age. It was primarily a time of improving on previous developments. The civilizations of classic Greece and Rome did not differ very much from the urban societies of the Bronze Age.

One new development was the invention of the alphabet for writing. Alphabetic writing is much easier than other forms of writing. Business accounts and other records were easier to keep. There was a greater spread of knowledge.

Iron working gradually spread throughout Africa, Asia, and Europe. People who otherwise might be called primitive came to use iron.

The Industrial Revolution

There were no great advances in Iron Age technology until about two hundred years ago. The Industrial Revolution replaced animal and man power with water, steam, and then electric power. Machines replaced tools, and factories then developed. The industrial city developed. Agriculture has been so improved that in the United States only five per cent of the labor force is needed to produce our food. In some parts of the world almost all of the people are still farmers.

Technological Lag

In this long story of man, over a million years old, cultural advances have not been even. In the Paleolithic, some people invented better ways of making tools while the others did not. Today the lag between parts of the world is even greater. There are countries with a great industrial technology, such as the United States, Russia, and the European countries. And then there are countries where most of the people live as their ancestors did thousands of years ago.

We sometimes think that Europe was always ahead of the rest of the world. At the time of the Romans, most of Europe was inhabited by crude hunters. These barbarians were held in contempt by the advanced peoples of the Mediterranean.

The cultural development of man has been very uneven. Natural resources have been different. Some people were isolated from the mainstreams of invention. But in the long story of man, it seems that all can reach the same levels of culture when they have the chance. An understanding of man's prehistory and slow cultural development may help us better understand the problems of cultural change.

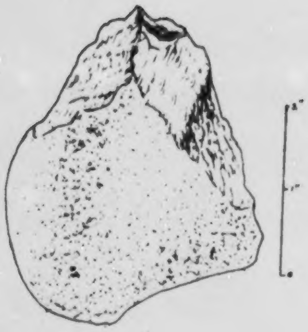
SUMMARY OF

Periods	Tools	Earning a Living
Iron Age and Bronze Age 5,000 years ago	Iron and bronze tools gradually take the place of stone tools.	Most people still herded animals or farmed but an increasing number worked at specialized jobs such as pottery making.
Neolithic Age 9,000 years ago	Polished stone tools and microliths mounted on handles.	Herding goats and sheep and growing wheat.
Mesolithic Age 10,000 years ago	Microliths mounted on handles.	Advanced types of hunting with bows and arrows and fishing with nets—wild plant food was gathered.
Upper Paleolithic Age—40,000 years ago	Many types of blade tools and bone tools, some of which are mounted on handles.	Organized hunts for large animals, use of spears with stone or bone points. Gathering of wild plant food.
Middle Paleolithic Age—190,000 years ago	Tool-making techniques only very slightly improved over the Lower Paleolithic.	Hunting techniques only slightly improved over the Lower Paleolithic.
Lower Paleolithic Age—one million or more years ago	Crudely chipped stone tools held in the hand rather than mounted on handles.	Hunting animals with wooden spears, trapping animals in pits, gathering wild plant food.

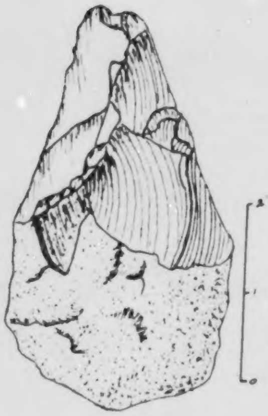
OLD WORLD PREHISTORY

Housing	Other Developments	Social Group
Most people still lived in neolithic villages but in cities some lived in houses of two or more floors.	Increasing trade of goods and ideas from one area to another	Cities and Empires
Permanent houses of wood or mud brick built in small walled villages	Some men began to specialize in certain jobs	First permanent villages
Temporary man-made shelters	Man begins to spread throughout the world	Related small groups spend part of the year together in areas with much wild food.
First art—cave paintings	First art—cave paintings; first fitted clothing	Seasonally, small bands of hunters gather to cooperate in large animal drives
Caves and open plain	First burial of the dead; possibly first use of clothes	Hunting bands possibly increased in size
Caves and open plain	First use of fire	Small groups of 5 to 10 adults who were related to each other, plus children.

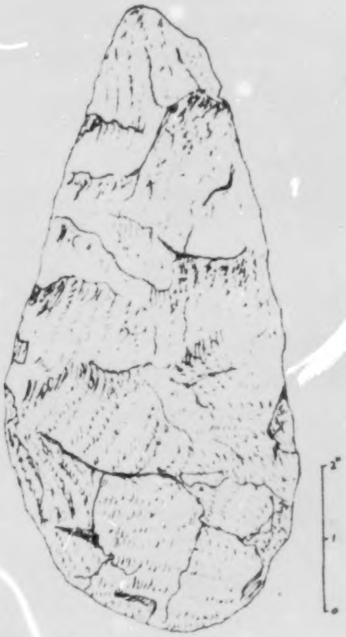
TOOLS OF OLD WORLD PREHISTORY



Pebble Tool

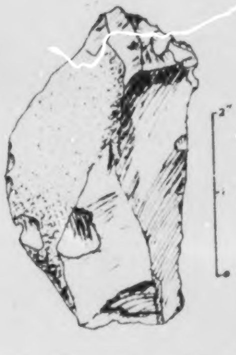


Hand Axe (Abbevillian)

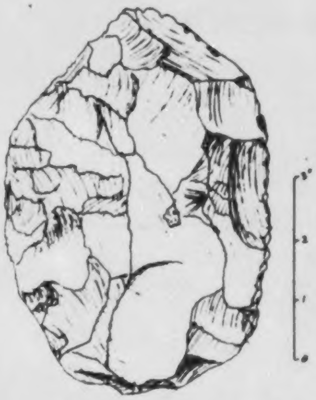


Hand Axe (Acheulian)

CORE TOOLS



Clactonian Flake Tool

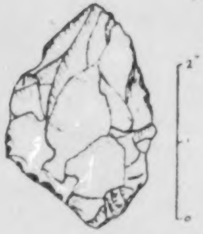


Levalloisian Flake

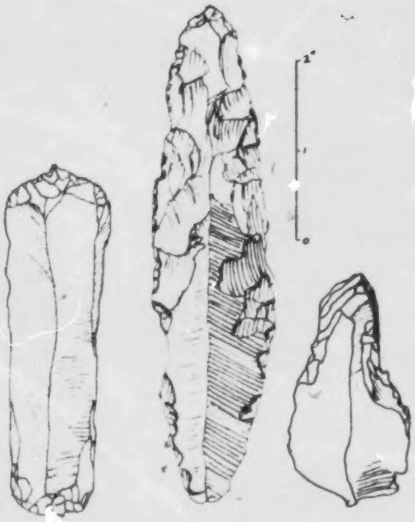
FLAKE TOOLS

LOWER PALEOLITHIC

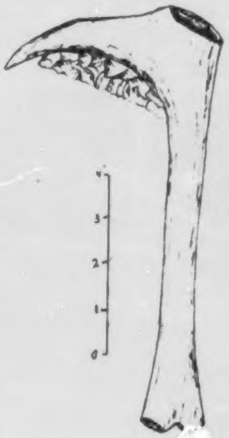
TOOLS OF OLD WORLD PREHISTORY



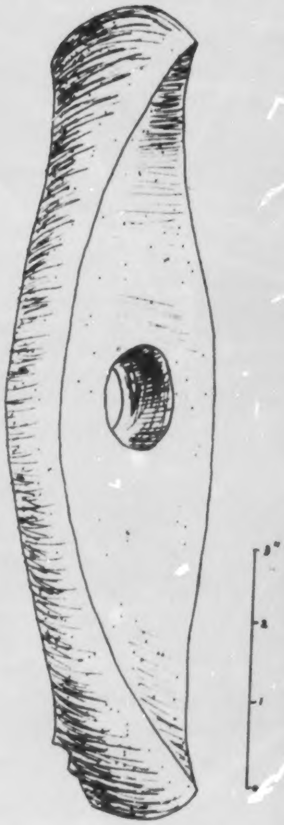
Levalloisian Flake



Blade Tools



Sickle

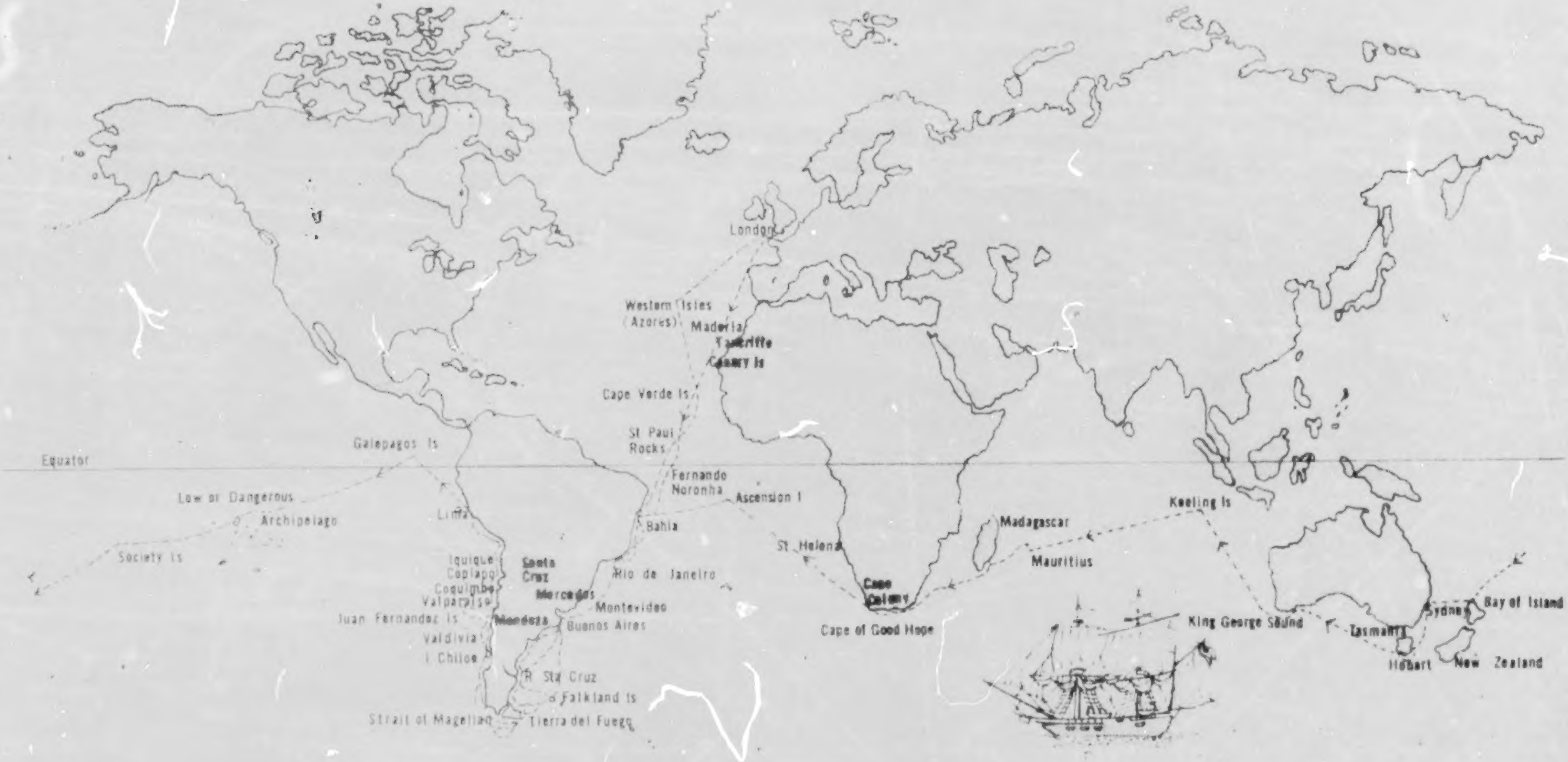


Polished Stone Axe

UPPER PALEOLITHIC

NEOLITHIC

Voyage of H.M.S. Beagle, 1831-1836


London
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Canary Is
Cape Verde Is
St Paul
Rocks
Galepagos Is
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Noronha
Ascension I
Low or Dangerous
Archipelago
Lima
Bahia
Society Is
St Helena
Madagascar
Keeling Is
Mauritius
Iquique
Copiapo
Coquimbo
Valparaiso
Santa
Cruz
Mercedes
Rio de Janeiro
Montevideo
Juan Fernandez Is
Mendoza
Buenos Aires
Valdivia
I Chiloe
R Sta Cruz
Falkland Is
Strait of Magellan
Tierra del Fuego
Cape
Colony
Cape of Good Hope
King George Sound
Tasmania
Sydney
Bay of Island
Hobart
New Zealand

THE DEVELOPMENT OF MAN AND HIS CULTURE

OLD WORLD PREHISTORY

The Anthropology Project Staff

The Anthropology Project at the University of Georgia is a cooperative project involving anthropologists from the Department of Sociology and Anthropology and a variety of specialists from the College of Education.

All members of the staff cooperate in the various phases of material development. Primary responsibility for material development is distributed as follows: anthropological concepts and teacher background material, anthropology; pupil text based on the teacher essays, project coordinator; art supervision, media specialist; teacher and pupil guides, elementary social studies specialist; test construction and validation, educational psychology; critical review, philosophy. Staff associates are assisted in their work by graduate research assistants.

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The Development of Man and His Culture; Old World Prehistory

Pupil's Study Guide
Fifth Grade

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Not for general classroom purposes

To be used in connection with "A Sequential Curriculum in Anthropology for Grades 1-7."

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THE DEVELOPMENT OF MAN AND HIS CULTURE:

OLD WORLD PREHISTORY

Anthropology will give you many new ideas. It will introduce you to many new words. Also, it will provide you with a scientific way to think about the way your American culture developed. Finally, it will suggest scientific concepts to use when thinking about the development of the cultures of other people.

This study guide will help you get the most from the unit, "The Development of Man and His Culture." Each chapter contains the following:

Word list. It is important to learn the anthropological words. To think about people in the way that an anthropologist does, you must learn the words he uses.

Key ideas. These will help you study the most important things in each chapter.

Things to do. The things to do will help fix in your mind the key ideas and words. You may think up other things which you want to do.

Thought questions. These cannot be answered directly from any one part of the text. To find answers, you will have to apply the knowledge learned.

Review questions. These will help you check to see how well you know some of the ideas in the unit.

Vocabulary. On pages 13-21 of the study guide, there is a vocabulary list. It tells what the anthropology words mean. It also tells what some other words in your book mean.

Study Guide. Before studying a chapter in your book, read the study guide. This will tell you what the chapter will be about. It will help you in your reading of the chapter.

Pupil Text. Read the pupil text and then reread the study guide again. It will help you to understand and remember what you have read.

Completion sentences. There is a set of sentences in the back of the study guide. Your teacher will explain how to use this set of completion sentences.

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Chapter I

ARCHEOLOGICAL METHODS

This chapter on archeological methods describes how archeologists study people and cultures of the past. It describes the tools, methods, and techniques an archeologist uses. The material presents archeology as a science. Studying the ways an archeologist works should arouse your interest in learning about man's past.

This chapter is not designed to train you as an archeologist. It takes many long years of study and field work to become a good archeologist. You should not try to excavate an archeological site. Much damage has been done to important archeological sites by untrained excavators.

A. Anthropological terms I must use:

- absolute dating
- aerial
- anthropologist
- anthropology
- archeologist
- archeology
- artifacts
- calendrical dating
- carbon-14 dating
- ceremonial site
- dendrochronology
- excavate
- fauna
- flora
- geology
- habitation site
- history
- historian
- inorganic
- interpretation
- invention
- midden
- organic
- paleontologist
- peat bogs
- photography
- potassium-argon dating
- preservation
- publication
- quadrant
- relative dating
- restoration
- seriation
- site
- strata
- stratigraphy

B. Key ideas I am to look for and learn about are:

1. What is archeology?
2. What is an archeologist?
3. How do archeologists study about cultures of the past?
4. Why should an archeologist tell other people about the things he finds?
5. How much can be found out about a culture of the past?

C. Things I can do:

1. Read about the work of the archeologist and write a brief report of the work they do. You might share this report with the class.
2. Draw a series of pictures showing how an archeologist might excavate the floor of a cave. Make a bulletin board using these pictures.
3. With the help of some friends make a collection of the different tools that an archeologist might use. Show these tools to the rest of the class and tell how they are used.
4. Write a story telling what might happen if an archeologist of the future were to dig in your city dump. What would he find? What could he tell about the way you and your friends lived?

D. Questions to help me think.

1. Why is the work of the archeologist important? How does it help you, if more is learned about the people of the past?
2. What parts of a culture is the archeologist most likely to find out the most about? What parts is he likely to find out the least about?
3. Why is salvage archeology necessary? Can you think of some part of the world where salvage archeology is going on today?

4. Why is it necessary for the archeologist to be very careful when he is excavating? What important bits of knowledge might be lost by a careless archeologist?

E. Review questions:

1. What is an archeologist?
2. How does an archeologist decide where to excavate?
3. What are the different types of sites an archeologist will find?
4. Where will an archeologist find the most things preserved?
5. What are the different techniques an archeologist uses to dig at a site?
6. Can an archeologist find out all about a past culture from what he digs up?

Chapter II

EVOLUTION

Evolution is one of the most important ideas of modern science. Many areas of study use the concept of evolution.

Evolution is best described as change through time. The material in this chapter will cover changes that take place in living things. Changes in living things is called organic evolution.

The findings of scientists working over many years contributed to the modern explanation of evolution. The discoveries of one scientist, Charles Darwin, are most often explained in connection with evolution. The work of Darwin is only part of the research in this area.

The material in this chapter will help you to better understand the material in the next chapter on "Fossil Man." The chapter on "Fossil Man" summarizes the physical development of man and discusses the changes that have taken place in man over the years.

A. Anthropology words I must use:

- adaptation
- Beagle
- biology
- binomial system
- Cambrian
- comparative anatomy
- cultural anthropology
- culture
- Darwin, Charles
- evolution
- expedition
- extinct
- fossil
- gene
- generalized animals
- genetics
- genetic drift
- glacial
- heredity
- Holocene
- interglacial
- Malthusian theory
- migration
- mutation

natural selection
On the Origin of Species by Means of Natural Selection
(Origin of Species)
organic
Paleocene
paleontology
physical anthropology
Pleistocene
Pliocene
sedimentary
specialized animals
synthesis
variations

B. Key ideas I am to look for and learn about are:

1. What is evolution?
2. How does evolution take place?
3. How does man's culture affect his evolution?
4. What is a fossil?
5. How old is the earth?
6. How old is life on earth?
7. How long has man been on earth?
8. What is anthropology?
9. What is an anthropologist?

C. Things I can do:

1. Read about the lives of monkeys and great apes.
2. Make a chart showing the evolution of the horse or some other animal.
3. Make a report to the class on an extinct animal.
4. Find out what changes have taken place in domesticated animals in modern times.

D. Questions to help me think:

1. Could you find a fossil of an animal or plant similar to those alive today? Explain.
2. Joe is faced with the problem of being cold. In what different ways might he solve this problem.
3. Anthropology is the study of man as an animal and as a being with culture. Why is it necessary to study man in both these ways?
4. Many millions of years ago many giant fern-like plants as tall as the trees of today grew on the earth. What possible reasons could you give for the disappearance of these large plants.

E. Review questions:

1. What is evolution?
2. How does natural selection operate?
3. What is a fossil?
4. What is man's environment?
5. What is anthropology?

Chapter III

FOSSIL MAN

Studying about fossil man is important for several reasons. First, the fossil remains of early man help us to understand the evolution of man. Second,fossil remains help us to understand the great length of time that man has been on earth. Thus we can see the period of time that has been necessary for man's culture to develop. Last, they help us to understand man as a living creature that has culture.

The names of early man will aid you in organizing scientific information about man's development. Only man has developed the physical traits that make it possible to have culture. Some of these characteristics are the opposable thumb, walking upright, and an effective brain. It is necessary to learn man's physical history before you can study about his cultural history.

A. Anthropology terms I must use:

Australopithecus (ae, plural)
Caucasoids
Cro-Magnon Man
genus
Hominidae
Hominid
Homo erectus
Homo erectus (Java Man)
Homo erectus Pekinensis (Peking Man)
Homo sapiens
Homo sapiens Neanderthalensis (Neanderthal Man)
Homo sapiens sapiens
Homo sapiens spaelus
Mestizo
Mongoloids
Negroids
species, sub-species

B. Key ideas I am to look for:

1. How long has man been on earth?
2. Who was the first man to use tools and fire?
3. Who was the first modern man?
4. How much can we tell about ancient man from the remains that are found?
5. How many species of man now live on earth?

C. Things I can do:

1. Make a time line showing the various forms of fossil man and when they lived. Place it over the chalk board at the front of the room.
2. Get a skeleton from the science supply room and learn something about the various parts of it. Describe these for the rest of the class.
3. Make a collection of pictures of the way various artists think different types of early man may have looked. Look for differences in the pictures.
4. Make a chart showing the changes that have taken place in the skeletal structure of man since early man.

D. Questions to help me think:

1. Why do you believe man has changed during the past million years?
2. What reasons could you suggest for studying early man?
3. What changes have taken place in the form of modern man in the last 800 years?
4. What are the most obvious differences in the skeletal form of fossil man and modern man? What do these differences indicate about the way these people lived and worked?

E. Review questions:

1. How was early man different from modern man?
2. How long has man been on earth?
3. What were the most important inventions of early man and who were the first to use them?
4. How many species of man now live on earth?

Chapter IV

OLD WORLD PREHISTORY

Very little of the history of man has occurred during the time of written records. Man lived for hundreds of thousands of years before writing. Men who lived in prehistoric times has, however, left behind many things. Anthropologists learn much about past cultures from these remains. Tools, weapons, cave paintings, pottery, and other remains are clues to how early man lived.

At first man's culture changed very slowly. It was not until about 10,000 years ago that rapid changes began. Since then, new developments have appeared more frequently. There was, however, no sudden change from one cultural period to another.

All changes that have taken place in man's culture have not come at the same time in all parts of the world. At some time, almost all sections of the Old World made some important contribution to the growth of this culture. These developments took place not only in Western Europe but also in Asia and Africa.

A. Anthropology words I should use:

alphabet
alloy
awls
blade
burins
chopper tool
core tools
culture
flake
hand axe
Holocene
Industrial Revolution
Mesolithic

microliths
Neolithic
Paleolithic
patterned toolmaking
pebble tool
Pleistocene
pressure flaking
ritual
smelted
social group
spear thrower
specialization
stalking

technology
tool
toolmaking tradition
urban
ziggurats

B. Key ideas I am to look for and learn about are:

1. How long were prehistoric times?
2. What changes have taken place in the earth's climate?
3. How did primitive men get their food?
4. What types of tools did primitive men use?
5. Where did primitive men live?

C. Things I can do:

1. Collect pictures of children engaging in activities like those which early men might have done.
2. Make a scrapbook of the pictures cut from magazines as mentioned in 1. above.
3. Select pictures from those collected by the class and mount on poster boards to show the Paleolithic, Neolithic and post Industrial Revolution:
    a. How man got his food
    b. What weapons he used
    c. What types of houses he used.

D. Questions to help me think:

1. How was the life of Lower Paleolithic man different from the life of Neolithic man. Why was it different?
2. How would the things Neanderthal Man consider important differ from those you consider important? What things would be the same?
3. Why could the Neolithic begin at different times; at different places?
4. What possessions would settled people likely have that nomadic people could not easily have?

5. Why do you think some people live today essentially as Neolithic people did?

E. Review questions:

1. What was the major advance of the Neolithic?
2. What changes have taken place in the earth's climate?
3. What is the difference between a culture and a tradition?
4. What is the basis for the division of man's past into stages?

VOCABULARY
(GLOSSARY)

absolute dating - A method of dating which gives a more or fixed year, such as A.D. 1,000.

adaptation - changing in order to fit better.

aerial - from the air.

alphabet - a system of characters or signs for representing sounds.

alloy - a material formed by combining two or more metals.

anthropologist - a scientist who studies man and his culture.

anthropology - the study of man and his culture.

archeologists - men who study how man lived long ago.

archeology - the branch of anthropology dealing with the study of how man lived long ago.

artifacts - things made by man.

Australopithecinae - the earliest type of man-like being who walked upright and lived in Africa from 1,750,000 to 500,000 years ago.

awls - a tool for making holes in wood, bone, or other things.

Beagle - the name of the ship on which Charles Darwin was naturalist.

biology - the study of living things.

binomial system - a two name system of classification.

blade - a long stone flake struck from a prepared core using a bone punch and a club or stone.

burins - a small stone chisel which was used to make other tools out of bone or horn.

calendrical dating - a method of dating using different calendar systems developed by man.

Cambrian - the period in the earth's history during which life on earth began.

carbon-14 dating - a method of absolute dating based on the amounts of radio-active carbon left in a once living object.

Caucasoids - the race of men originating in Europe.

ceremonial site - a place where people only came for some religious rite or festival.

chopper tool - a stone core tool which had a broad edge like a modern axe. A chopper tool was held in the hand.

comparative anatomy - the study of how animals are alike and unlike in their structure.

core tool - a tool made by removing flakes from a core.

Cro-Magnon Man - a prehistoric type of man of the same group as modern man. A Cro-Magnon Man dressed like us could probably walk down the street unnoticed. (Homo sapiens sapiens)

cultural anthropology - the study of man in relation to culture.

culture - the way of life of a group of people; the way in which a group adjusts to its total setting.

Darwin, Charles - a nineteenth century naturalist who wrote *On The Origin of Species by Means of Natural Selection*, an important contribution to the evolutionary thought of his day.

dendrochronology - tree ring dating.

evolution - a scientific explanation for the origin and development or slow change of living things.

excavate - the systematic digging of a site.

expedition - a trip of some length taken with a goal or objective in mind.

extinct - died out.

fauna - animal life.

flake tool - the stone chip struck from a core and used as tools.

flora - plant life.

fossil - the remains or traces of plants or animals which lived in an earlier period.

gene - the chemical unit which controls heredity.

generalized animal - an animal which is not adapted to one special environment.

genetics - the study of heredity.

genetic drift - the accidental loss of genes from those possessed by a population.

genus - a large division of plants or animals having certain characteristics in common.

geology - the study of earth's surface. Geology is sometimes used in dating objects or sites.

glacial periods - periods during which large areas of North America and Europe were covered with layers of ice.

habitation site - a place where people lived.

hand axe - a pointed, pear shaped core tool used by some early men. This all-purpose tool was held in the hand.

heredity - the sum total of what one inherits.

history - the study of our past from written records.

historian - a scholar who uses written records to write about man's past.

Holocene - the geologic epoch which began about 10,000 years ago. The modern and present geologic epoch.

Hominid - the family of man-like types.

Homo erectus - a species of man who lived after Australopithecus and during the Middle Pleistocene 500,000 to 200,000 years ago. The species includes *Homo erectus erectus* and *Homo erectus pekinensis*.

Homo erectus erectus (Java Man) - a sub-species of *Homo erectus* who lived in Java.

Homo erectus pekinensis (Peking Man) - a sub-species of *Homo erectus* who lived in China and used fire.

Homo sapiens - the species of men who lived from 200,000 to the present including *Homo sapiens neanderthalensis*, *Homo sapiens spaelus*, Cro-Magnon Man and all living men.

Homo sapiens neanderthalensis (Neanderthal Man) - a sub-species of *Homo sapiens* who lived from 200,000 to 80,000 years ago during the third interglacial and into the fourth glaciation.

Homo sapiens spaelus - a sub-species of *Homo sapiens* who lived at the same time as *Homo erectus* and also at the same time as Neanderthal Man.

Industrial Revolution - the technological advances which occurred about 200 years ago. Animal and manpower were replaced by water, steam, and electric power. Machines replaced tools.

inorganic - materials which have never been alive.

interglacial periods - the periods between glaciations during which the glaciers melted and the climate was much warmer.

interpretation - the explanation of what has been found.

invention - intentional development of new material or non-material things.

Mesolithic - the cultural period which began about 10,000 years ago and lasted for about 3,000 years. It was a time of rapid technological improvement.

Mestizo - a new emerging race of Latin America which is a result of the mixing of invader groups with the native Indians.

microliths - small sharp stones set in the handle or shaft of a tool.

midden - a village dump or refuse heap.

migration - the coming into, or going out of a population.

Mongoloids - the race of men originating in eastern Asia.

mutation - the change in the chemical structure of the gene.

natural selection - the process whereby the plant or animal best adapted to their environment are most likely to survive and leave offspring.

Negroid - the race of men originating in Africa.

Neolithic - the cultural period which began about 7,000 to 6,000 B.C. with the gradual replacement of hunting and gathering by food production.

On the Origin of Species by Natural Selection - the book written in 1859 by Charles Darwin which stated his ideas on evolution.

organic - materials which were or are living (plants and animals).

Paleocene - the geologic epoch during which mammals became numerous.

Paleolithic - the first and longest period of man's past which lasted a million years or more.

paleontologist - a man who studies the science of extinct life based on fossil remains.

paleontology - the science which studies once living forms of life.

patterned toolmaking - making tools a certain way over and over again according to a plan.

peat bogs - a damp soft area composed of decaying vegetation.

photography - the art of taking pictures with a camera.

physical anthropology - the study of man as a member of the animal kingdom.

Pleistocene - the geologic epoch during which ice covered a large area of the world.

Pliocene - the geologic epoch in which fossil man first appeared.

potassium-argon dating - a method of dating materials containing potassium. Potassium-argon dating is based on the gradual decay of potassium 40 to argon 40.

preservation - the job of keeping something in its original condition.

publication - printed in books and journals.

quadrant - the excavation of one-fourth of the site area.

relative dating - a method of dating which does not give a fixed date but tells you only if an object or site is older than some other site.

restoration - the process by which broken artifacts and artifact traces are put back together.

ritual - an act or series of prescribed acts performed for a purpose.

sedimentary rocks - rocks made up of layers of sediments such as mud, sand, and gravel.

seriation - a method of relative dating based on the type or style of an object.

site - the place where things are to be found.

smelted - to melt ore in order to separate the metal contained.

social group - a group of people who have certain values in common.

spear thrower - a device which gives additional force or leverage to a thrown spear.

specialization - full-time work at one particular craft or skill.

specialized animal - an animal which is well adapted to one special environment.

species - a basic category of classification for a single kind of animal or plant all members of which are essentially the same.

stalking - pursuing game animals stelthily or under cover.

strata - layers of materials such as soil, clay, or rock.

stratigraphy - a method of relative dating which uses the layer of earth in which an object is found to tell whether it is older or less old than another object.

sub-species - a subdivision of a species.

synthesis - something made up of different parts and put together in a clear and logical manner.

technology - all of the techniques possessed by the members of a society.

tool - any material device employed by man to transform raw materials into a more usable form or to construct other or more elaborate tools.

toolmaking tradition - making tools over a period of time according to a particular pattern.

urban - having to do with cities and towns.

variations - differences.

ziggurat - stepped pyramid with a temple on the top.

APPENDIX

Grade 5

THE DEVELOPMENT OF MAN AND HIS CULTURE:

OLD WORLD PREHISTORY

Completion Sentence Study Exercises

Directions

A set of study exercises has been made for each chapter. The study exercises are made up of sentences with a blank to fill in. Study sentences with blanks to fill in are completion sentences. Complete the sentences by writing the best answer in the blank.

To help you remember the right answer, there are three words under the blank. Select the correct word. Write the correct answer in the blank. Be certain that you spell the word correctly. If you do not remember the right answer, reread your text to find the best answer.

These study sentences have been grouped under a main idea. They will help you to master many of the important ideas in the chapter.

Chapter I

ARCHEOLOGICAL METHODS

Many sciences help us understand about past and present men. Here are some questions to help you learn about these sciences.

1. The study of man and his culture is ____________________.
(geology, anthropology, archeology)

2. A scientist who studies about man is called a(an)
____________________________________.
(geologist, anthropologist, archeologist)

3. The study of our past from written records is
____________________________________.
(history, geology, anthropology)

4. A scholar who uses written records to write about man's past is called a(an) ____________________________________.
(historian, geologist, anthropologist)

5. The study of how man lived long ago is
____.
(archeology, anthropology, history)

6. __________________________ is a branch of anthropology.
(history, archeology, geology)

7. A(An) ________________________ who studies how man lived long ago is an archeologist.
(geologist, biologist, anthropologist)

Things made by man are called artifacts. Here are some questions to help you understand about artifacts.

8. ___________________________ materials last a long time.
(organic, inorganic, wood)

9. ______________________ materials usually do not last a long time.
(organic, inorganic, stone)

10. Artifacts can tell us about ____________ of man's prehistory.
(all, part, none)

11. Artifacts may be found in a village midden or ____________________.
(dump, tomb, mound)

12. The archeologist tries to ________________ the artifacts he finds.
(destroy, understand, hide)

13. Artifacts can tell us about the ____________________.
(past, future, present)

An archeological site is an area used by man. Many archeological sites have been found. Here are some questions to help you understand how the Archeologists refer to sites.

14. A boy walking along on a hike found many pieces of broken Indian pottery. He had found this site by ______________________.
(planning, chance, design)

15. Heavy rains sometimes wash the dirt away from around artifacts. These sites are uncovered by ________________________.
(man, habitation, erosion)

16. Archeologists sometimes walk miles intently examining the ground and __________________ for sites.
(looking, turning, waiting)

17. Sites are sometimes classified by where they are found or ______________________________.
(location, scriation, aviation)

18. A very dry climate provides good preservation in __________________________ sites.
(desert, jungle, under water)

19. Sites in very ______________ areas provide poor preservation because things decay quickly.
(wet, dry, cold)

20. Sites may also be classified by what was done there or __________________
(use, habitation, historic)

21. A site where people lived is called a __________________________ site.
(habitation, ceremonial, historic)

22. People came for a religious rite or festival to __________________________ sites.
(habitation, burial, ceremonial)

23. Places where the dead were buried are called __________________________ sites.
(habitation, burial, living)

24. Sites may also be classified by the ________________ they existed.
(time, size, way)

25. Sites where written records are found as well as artifacts are called ________________________ sites.
(prehistoric, historic, modern)

26. A site for which there are no written records is called a ______________________________ site.
(prehistoric, historic, old)

The archeologist uses scientific methods to excavate a site. Here are some questions to see if you understand how the archeologist works.

27. The archeologist uses pegs and strings to lay off the site into ____________________.
(squares, trenches, ditches)

28. The method of excavation which involves digging a ditch through the site from top to bottom is called ____________________ method.
(ditch, trench, hard)

29. A ____________________ of pits may be used to excavate a shallow site.
(group, checkerboard, quadrant)

30. Excavation of one-fourth of the site area is called the ____________________ method.
(checkerboard, trench, quadrant)

31. The most complete record of a site is provided by ____________________ excavation.
(checkerboard, trench, total)

32. The archeologist uses many kinds of ____________________ to excavate.
(animals, books, tools)

33. Sometimes a ____________________ is used to remove a thick layer of dirt contianing no artifacts.
(shovel, bulldozer, pick)

34. It is important that an archeologist keep a ____________________ of what he finds in the earth.
(record, piece, lot)

The dating of objects is very important to the archeologist. Here are some questions to see if you understand about the dating of objects.

35. The dating method which tells whether an object or site is older than some other object or site is called ____________________________ dating.
(absolute, relative, carbon 14)

36. The strata or layers of the earth are used in the dating of objects by ______________________________.
(carbon 14, stratigraphy, seriation)

37. The series or styles of pottery for instance may help in dating a object by _______________________.
(absolute dating, stratigraphy, seriation)

38. A knowledge of plants and animals helps the archeologist to date sites using ___________________________.
(geology, biology, Potassium-argon)

39. Changes in the earth's surface help the archeologist to use the science of _______________________________ in dating objects and sites.
(geology, biology, history)

40. The dating method which gives a more or less fixed date is called _____________________________.
(relative, absolute, seriation)

41. Dendrochronology is called _____________ ring dating.
(twig, tree, wood)

42. Dating by different calendar systems is called ____________________________ dating.
(calendar, calendrical, relative)

43. The amount of _______________ 14 can be used to tell the age of organic materials.
(carbon, argon, potash)

44. Very old rocks may be dated by the amounts of
_______________________ and argon in them.
(potash, potassium, gold)

An archeologist does not spend all his time digging. Here are some questions to see if you understand how the archeologist goes about the final work of the project.

45. Often the objects are dirty and need to be
____________________.
(burned, cleaned, discarded)

46. Some objects must be kept from falling to pieces when
exposed to the air by __________________________.
(petrification, preservation, publishing)

47. Many broken or decayed objects need to be put back
together by the process called ____________________.
(petrification, remodeling, restoration)

48. Accurate information about an artifact is needed for
the records. The final step in laboratory work is
thus __________________________ of the artifact.
(description, cleaning, remodeling)

49. When an archeologist explains what he has found this
is called ___________________________.
(ideas, interpretation, description)

50. When an excavation is finished an anthropologist
writes about what he has found and _________________
his findings.
(files, publishes, reads)

Answers to completion questions about Archeological Methods.

1. anthropology
2. anthropologist
3. history
4. historian
5. archeology
6. archeology
7. anthropologist
8. inorganic
9. organic
10. part
11. dump
12. understand
13. past
14. chance
15. erosion
16. look (or search)
17. location
18. desert
19. wet
20. use
21. habitation
22. ceremonial
23. burial
24. time
25. historic
26. prehistoric
27. squares
28. trench
29. checkerboard
30. quadrant
31. total
32. tools
33. bulldozer
34. record
35. relative
36. stratigraphy
37. seriation
38. biology
39. geology
40. absolute
41. tree
42. calendrical
43. carbon
44. potassium
45. cleaned
46. preservation
47. restoration
48. description
49. interpretation
50. publishes

Chapter II

EVOLUTION

Anthropologists need to know about the origin and development of man. To understand about this they study evolution. Here are some questions to see if you understand about evolution and anthropology.

1. A scientific explanation for the origin and development of living things is ______________________________.
(anthropology, evolution, biology)

2. The branch of anthropology which studies man as a member of the animal kingdom is
____.
(cultural anthropology, physical anthropology, geology)

3. The branch of anthropology which studies man in relation to culture is ______________________________.
(physical anthropology, cultural anthropology, evolution)

4. Anthropologists believe man appeared during prehistoric times because of the ______________________________ he left behind.
(notes, tools, language)

5. Organic materials are ____________________ things.
(living, not living, old)

The foundations of Evolutionary Thought are very old. Here are some questions to see if you understand about evolutionary thought.

6. Charles ______________ was the English scientist who explained organic changes in animals.
(Malthus, Darwin, Smith)

7. A classification system for living things which uses two names for each thing is called a
____________________________ system.
(extinct, binomial, classification)

8. These two names are the genus name and the
___________________________ name.
(system, species)

9. The structure of animals is referred to as their
______________________________.
(anatomy, stratigraphy, shape)

10. Many animal species are no longer alive. They are said to be __________________________.
(extinct, living, rotten)

11. Layers of mud, sand, gravel, and soil make up
________________________________ rocks.
(sedimentary, erosion, stratigraphy)

12. Scientists have found that the earth is very
__________________________________.
(young, old, very young)

13. The science of old living things is called
____.
(paleontology, geology, pathology)

Charles Darwin made an important discovery. Here are some questions to see if you understand what he found.

14. Darwin was the naturalist of a scientific
___________________________ to study the coasts of South America and some of the Pacific Islands.
(expedition, report, plan)

15. On the trip Darwin saw many things that made him ask why species seemed to vary with their
______________________________.
(climate, environment, origin)

16. When Darwin returned to England after the trip, he studied the work of Thomas ________________________.
(Darwin, Malthus, Jefferson)

17. Many more living things start life than grow up. Darwin thought the ones that survived must be the ones best ________________________ to their environment.
(adapted, varied, related)

18. Differences among like species are called
__________________________________.
(adaptations, variations, completions)

19. *The Origin of Species By Means of Natural Selection* is the title of a book by ___________________________.
(Darwin, Malthus, Clay)

It is very important to understand the modern explanation of evolution. Here are some questions to see if you know about these facts.

20. Natural ___________________________ is now viewed as a part of the modern synthetic explanation of evolution.
(selection, habits, inheritence)

21. The inheritance of characteristics from parents is controlled by ___________________________.
(species, drift, heredity)

22. One-half of the ____________________ come from each parent.
(genes, synthesis, section)

23. The chemical unit that controls heredity is called a ______________________.
(egg, gene, mutation)

24. In various plants and animals the number of ______________________ differ.
(genes, legs, selections)

25. Anthropologists are interested in genetics because it helps to explain how new types of ______________________ develop.
(men, plants, genes)

26. A change in the chemical structure of a gene is called a ______________________.
(change, mutation, selection)

27. The basis for evolution is formed by natural selection and ______________________.
(genes, heredity, mutations)

28. Mutations may be desirable, undesirable or unimportant. Most mutations, however, are ______________________.
(desirable, undesirable, or unimportant)

29. Addition or subtraction of genes in a population may be caused by genetic ______________________.
(change, drift, heredity)

30. When an animal fits well into a certain environment it can be said to be ______________________.
(generalized, specialized, happy)

31. Man is a ______________________ animal. He fits well into many environments.
(specialized, happy, generalized)

The anthropologists are interested in fossils and the evolution of life on the earth. Here are some questions to help you understand about this.

32. The age of ________________ is about 4.5 billion years.
(the earth, man, life on earth)

33. Life has been on earth about 500 ______________ years.
(million, thousand, billion)

34. The most common form of preservation occurs when an object is covered by ______________________.
(sediment, lava, snow)

35. From fossils anthropologists can estimate the weight, body build, posture and ________________ of early man.
(height, finger prints, skin color)

36. During the Paleocene Epoch, 75 million years ago, ____________________ became numerous.
(mammals, man, rocks)

37. The Ice Age was during the ________________ Epoch.
(Pleistocene, Paleocene, Neocene)

38. The Pleistocene was not just a period of glacial advance. There were four advances and three ______________________ of the glaciers.
(retreats, advances, preservations)

39. The warm periods between glacial advances are called ___________________________.
(interglacials, freezing, fossils)

40. The present geologic epoch is the __________________.
(Holocene, Neocene, Pleistocene)

Answers to completion questions about Evolution:

1. evolution
2. physical anthropology
3. cultural anthropology
4. tools
5. living
6. Darwin
7. binomial
8. species
9. anatomy
10. extinct
11. sedimentary
12. old
13. paleontology
14. expedition
15. environment
16. Malthus
17. adapted
18. variation
19. Darwin
20. selection
21. heredity
22. genes
23. gene
24. genes
25. men
26. mutation
27. mutations
28. undesirable
29. drift
30. specialized
31. generalized
32. earth
33. million
34. sediment
35. height
36. mammals
37. Pleistocene
38. retreats
39. interglacials
40. Holocene

Chapter III

FOSSIL MAN

Men have lived on the earth for a very long time. Here are some questions to help you understand about fossil man.

1. The oldest known human-like forms were the
   ____________________________________.
   (Australopithecinae, Homo erectus, Homo sapiens)

2. The early types of man which began to appear one and a half million years ago are called
   ____.
   (Hominids, Homo, "missing link")

3. The form of man that lived from 1,500,000 to 500,000 years ago was ______________________________.
   (Australopithecus, Java Man, Peking man)

4. The remains of Australopithecus were found in
   ____________________________________.
   (Asia, Africa, Europe)

5. Australopithecus walked _________________________
   probably with a shuffling gait.
   (upright, on all fours, did not walk)

6. Australopithecus made and used _____________________
   tools.
   (pebble, old, metal)

Different fossil men, the Homo erectus, lived after the Australopithecinae. Here are some questions to see if you understand about them.

7. Homo erectus lived in the middle ___________________.
   (Pleistocene, Paleocene, Holocene)

8. Homo erectus types lived about ____________________
to 200,000 years ago.
(300,000, 100, 500,000)

9. Two Homo erectus are Java Man and
____.
(Peking Man, Australopithecus, Cro-Magnon Man)

10. Homo erectus stood and walked ____________________.
(erect, bent over, on all fours)

11. Homo erectus was about ____________________ tall.
(5 feet 6 inches, 6 feet, 5 feet 8 inches)

12. Homo erectus pekinensis (Peking Man) is the first
man known to have used ___________________________.
(fire, stone, bread)

The Homo sapiens were a more advanced type of men. Here are some questions to see if you understand about them.

13. Neanderthal man lived from about ____________________
to 80,000 years ago.
(200,000, 100,000, 90,000)

14. Neanderthal man lived in Asia, West Africa and
________________________.
(Europe, North America, Australia)

15. An incorrect idea of Neanderthal Man's posture
resulted from the examination of one skeleton of a
person who had a ____________________________.
(disease, broken leg, broken arm)

16. Now ______________________ remains of Neanderthal
Men have been found.
(100, 500, 2)

17. Another type of man that lived before and at the same time as Neanderthal Man was Homo sapiens
__________________________.
(spaelus, sapiens, erectus)

18. Neanderthal Man disappeared with the coming of the Upper ______________________________________.
(Paleolithic, Mesolithic, Neocene)

19. Modern man is also known as Homo sapiens ___________.
(sapiens, erectus, homo)

20. Modern man first appeared in the
__________________________________.
(Lower Pleistocene, Middle Pleistocene, Upper Pleistocene)

21. Cro-Magnon was tall and his facial features were very similar to modern ___________________________.
(Europeans, Asiatics, Africans)

22. The fossil record depends only on_____________________ remains.
(skeletal, skin, tool)

Modern races are changing. Here are some questions to see if you understand about modern races.

23. Differences based on non-skeletal things such as skin color, hair type, and eye color are
______________________________ differences.
(racial, cultural, basic)

24. The Caucasoid, Negroid, and Mongoloid types became identified only in the ___________________________.
(Pleistocene, Holocene, Paleocene)

25. A new race emerging in Latin America is the
__________________________.
(Negro, Mestizo, Indian)

Answers to completion questions about Fossil Man:

1. Australopithecinae
2. Hominids
3. Australopithecus
4. Africa
5. upright
6. pebble
7. Pleistocene
8. 500,000
9. Peking Man
10. erect
11. 5 feet 6 inches
12. fire
13. 200,000
14. Europe
15. disease
16. 100
17. spaelus
18. Paleolithic
19. sapiens
20. Upper Pleistocene
21. Europeans
22. skeletal
23. racial
24. Holocene
25. Mestizo

Chapter IV

OLD WORLD PREHISTORY

The anthropologists are interested in the development of culture. Here are some questions to see if you understand about some different cultures.

1. The Western Hemisphere is called the New World, the Eastern hemisphere is called the ______________________
(Old World, Middle World, Asia)

2. The ancestors of the American ______________________
came to the Western Hemisphere in the late Pleistocene.
(Indian, Bison, White men)

3. They came into North America by a ______________________
connecting Siberia and Alaska.
(land bridge, ice bridge, steel bridge)

4. Fossil men have been found in Africa, Asia, and Europe but not in ______________________.
(America, Java, France)

5. Prehistory of the Old World began during the early
______________________.
(Pliocene, Pleistocene, Paleocene)

6. The Pleistocene lasted for ______________ million(s) years.
(one, five, sixteen)

7. Most of the tools of very early man found by the archeologist are made of ______________________.
(stone, wood, metal)

8. We know about early man's toolmaking traditions from his ______________________________.
(language, houses, weapons)

9. Sometimes time is divided into geologic periods. During the ________________________ geologic period, ice and snow covered large portions of the earth.
(Pleistocene, Holocene, Zeocene)

10. The modern geologic period is the ______________________________.
(Pleistocene, Holocene, Pliocene)

Sometimes time is divided into periods by man's culture. Here are some questions to see if you understand about these periods.

11. The longest period of man's past is the ______________________________.
(Paleolithic, Mesolithic, Neolithic)

12. "Paleo" as used in Paleolithic means ________________ and the "lithic" means stone.
(old, new, young)

13 The Paleolithic is divided into three parts the Lower, Middle, and ____________________________ Paleolithic.
(Top, Recent, Upper)

14. The Paleolithic was followed by the ______________________________ period.
(Mesolithic, Neolithic, Middlelithic)

15. The cultural period which began about 10,000 years ago is the ____________________.
(Mesolithic, Paleolithic, Pleistocene)

16. "Meso" in Mesolithic means middle and the "lithic"
means ______________________________.
(stone, length, age)

17. The Mesolithic period was followed by the
______________________________ period.
(Neolithic, Newlithic, Paleolithic)

18. The Neolithic began at different times in different
places. In the Near East it began about
______________________ years ago.
(7,000, 10,000, 3,000)

19. "Neo" in Neolithic means __________________ and
"lithic" means stone age.
(new, need, name)

20. In the Bronze age some tools made of _______________
were used.
(bronze, copper, iron)

21. In the Iron age some tools made of ________________
were used.
(iron, bronze, stone)

22. Today we are living in the __________________age.
(Iron, Bronze, Stone)

Man has made many different types of tools.
Here are some questions to see if you remember about tools.

23. The two basic types of tools are the core and
______________________ tools.
(flake, pebble, chunk)

24. The earliest kind of core tool used by man is
called a ____________________tool.
(pebble, iron, blade)

25. A pear shaped tool with a sharp edge all around was the ____________________________.
(hand axe, blade, flake)

26. Flake tools were made out of ____________________ of stone.
(flakes, cores, slabs)

27. During the lower Paleolithic man used tools made both from ______________________ and from flakes.
(cores, blades, microliths)

28. Toward the end of the lower Paleolithic man began to make more advanced _________________________ tools which required little or no finishing.
(flake, bronze, pebble)

Many different types of fossil men have lived in the past. Here are some questions to see if you understand about their cultures.

29. The fossil men who lived during the Lower Paleolithic were ______________________ and Homo erectus.
(Australopithecus, Peking Man, Modern man)

30. Small animals, young animals and vegetation probably made up the diet of the early __________________. As time went on they helped each other in cooperative hunting.
(Australopithecinae, Romans, Cro-Magnon)

31. The remains of the culture of a Homo erectus were found near _____________________________ China.
(Peking, Inchow, Cowloon)

32. Peking Man was the earliest man known to have used ______________________________.
(fire, tools, wood)

33. Peking Man's basic tool was a ____________________.
(chopper, blade, pebble)

34. The size of the groups in which Peking man lived were probably ____________________________.
(large, small, medium sized)

35. Homo sapiens neanderthalensis is also called ______________________________ Man.
(Peking, Java, Neanderthal)

36. Homo sapiens neanderthalensis lived in the Middle ________________________________.
(Paleolithic, Neolithic, Mesolithic)

37. Neanderthal man is known for two accomplishments, extension of human settlement and __________________ of the dead.
(eating, burial, burning)

38. During the Upper Paleolithic, Homo sapiens sapiens or man of the ______________________ type appeared.
(old, modern, dead)

39. Homo sapiens sapiens made fitted clothing and did many ________________________ on cave walls.
(paintings, writing, studying)

40. Homo sapiens sapiens made many blades from one stone core and then removed small flakes by ____________________________________ flaking.
(pressure, wood, core)

41. The burin is a small stone _____________.
(axe, hammer, chisel)

42. Upper Paleolithic man used a ___________________ to make fitted clothes.
(sewing machine, pair of scissors, needle)

43. For Upper Paleolithic man ____________________ was still the main way of living.
(hunting, farming, fishing)

44. Upper Paleolithic men ____________________ their dead with ritual.
(ate, buried, burned)

45. As the Pleistocene or Ice Age ended the climate grew ____________________.
(colder, warmer, dryer)

The Mesolithic period man made many advances in technology. Here are some questions to see if you understand about the Mesolithic period.

46. The ____________________ period began about 10,000 years ago.
(Mesolithic, Neolithic, Paleolithic)

47. During the Mesolithic some of the improvements in technology that were made were microliths, stone axes, bows and arrows, fishhooks, and boats. The ____________ also was domesticated during this time.
(dog, cat, buffalo)

48. During the Mesolithic there was almost no ____________________.
(hunting, eating, painting)

The Neolithic was a period of revolutionary change. Here are some questions to help you understand this cultural period.

49. Man's change from a hunter and gatherer to a food producer is called the ____________________ revolution.
(New, Mesolithic, Neolithic)

50. This change probably occurred very ________________.
(quickly, slowly, knowingly)

51. Plants were independently domesticated in
_____________________ area(s).
(one, several, fifteen)

52. Two Neolithic sites in the Near East are Jarmo and
______________________________.
(Jerusalem, Jericho, Bethlehem)

53. Food production brought about the development of
_________________________.
(cities, villages, cooking)

54. Weaving of cloth and ______________________________
making were two important inventions associated
with Neolithic life.
(clothing, machine, pottery)

55. Villages were widespread in the Near East by
___________________________ years ago.
(8,000, 6,000, 2,000)

56. These early farmers lived together in
______________________________ settlements.
(temporary, camp, permanent)

The Bronze and Iron Ages followed the Neolithic. Here are some questions to help you understand about these Ages.

57. Some developments which led to the rise of
literate urban societies were more agricultural,
more ruling authority, specialization and
_________________________.
(money, travel, trade)

58. Craft specialization required a man to work ____________________ the time at one craft.
(all, part of, some of)

59. Trade on land was made easier by the invention of the ____________________.
(wedge, sled, wheel)

60. Trade by water was made easier by the use of ____________________.
(boats, rafts, sailboats)

61. Central authority was exercised by temple ____________________.
(women, boys, priests)

62. Bronze is an alloy of copper and ____________________.
(iron, silver, tin)

63. Five thousand years ago complex ____________________ cities developed in the Near East.
(village, group, urban)

64. The invention of the ____________________ made writing much easier.
(hieroglyphic, stylus, alphabet)

65. The ____________________ revolution occurred in some areas about 200 years ago.
(Neolithic, Iron, Industrial)

66. The culture and technological development of man in different areas has been ____________________.
(even, uneven, unknown)

Answers to completion questions about Old World Prehistory:

1. Old World
2. Indian
3. land bridge
4. America
5. Pleistocene
6. one
7. stone
8. culture
9. Pleistocene
10. Holocene
11. Paleolithic
12. old
13. Upper
14. Mesolithic
15. Mesolithic
16. stone
17. Neolithic
18. 7,000
19. new
20. bronze
21. iron
22. iron
23. flake
24. pebble
25. hand axe
26. flakes
27. cores
28. flake
29. Australopithecine
30. Australopithecine
31. Peking
32. fire
33. chopper
34. small
35. Neanderthal
36. Paleolithic
37. burial
38. modern
39. paintings
40. pressure
41. chisel
42. needle
43. hunting
44. buried
45. warmer
46. 3,000
47. dog
48. painting
49. Neolithic
50. slowly
51. several
52. Jericho
53. villages
54. pottery
55. 6,000
56. permanent
57. trade
58. all
59. wheel
60. boats
61. priests
62. tin
63. urban
64. alphabet
65. Industrial
66. uneven

THE DEVELOPMENT OF MAN AND HIS CULTURE

OLD WORLD PREHISTORY

Teacher Background Material

Grade Five

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ARCHEOLOGICAL METHODS

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ARCHEOLOGICAL METHODS

Introduction

Archeology is the division of cultural anthropology that deals with man's past. It is the scientific study of the material remains of past human life and activities--the remnants of the culture of the world's peoples.

Archeology is more than the glory of gold statuettes, elaborate mummy cases, the Rosetta Stone and Pompeii. Archeology is also painstaking research and plain hard work. Furthermore, like all science, it has no geographic boundaries: a Roman coin may hold the key to the dating of an Indian civilization; a Danish artifact could help clarify British prehistory.

Archeological material is important because of the light it sheds on the history of man and on the course of his development. Sir Leonard Woolley says that knowledge gained by scientific archeological methods "affects us all, becomes part of the general intellectual inheritance, and the justification of archeology is that it does in the end concern everyone."

By digging into the past we may be able to better evaluate our own culture and understand how we came to be as we are. The modernity of the elaborate drainage system of Knossus claims our admiration; an ancient grave may yield cosmetics surprisingly contemporary. It has been noted that people react to the sight of a relic in a museum in almost direct proportion to their recognition of its essential modernity.

Although method is necessary, the added ingredients of imagination, enthusiasm, patience, understanding of and sympathy with past cultures are what make an archeologist great. Such a man was Heinrich Schliemann. What he lacked in scientific methodology, he made up in dedication and unswerving belief in the Homeric epics. Troy *must* have existed. He would prove it. True, he made many errors, but his work at Troy showed that myth can be rooted in fact, and his findings at Mycenae gave a depth to Greek prehistory such as no one had dreamed possible. We can safely term his work monumental.

Until Schliemann dug at Troy and Mycenae, and Sir Arthur Evans at Crete, the real interrelation of archeology, history and prehistory had not been comprehended. Evans brought to light the glittering Minoan civilization--exposed for all to see. Its very existence had not even been suspected, for not a single written word had been found telling us of its past glory.

The history of Egypt has been recovered by archeological work. Today the archeologists working in Europe, China, Central America, and Turkestan are adding to our view of man's past. This knowledge does not result from the fact that ancient objects have been removed from the earth, but because these objects have been removed and interpreted scientifically.

Man has long been interested in digging into the remains of past cultures. Egyptian tombs were broken into and robbed; early Romans dug up Greek artifacts; the conquistadores, searching for gold, plundered Peruvian tombs; older artifacts have been found at American Indian sites--all indications point to their belonging to cultures pre-dating the ones under investigation.

With the Renaissance in Europe came renewed appreciation of the sculptures, pottery, and other objects belonging to the ancient civilizations of Egypt, Italy, and Greece. Private individuals who wanted personal collections encouraged digging. The desire to know more about their ancestors led some Europeans to excavate sites, particularly the plentiful and easily recognized Roman locations.

In the early days of America only a few digs were undertaken. The most remarkable of these was by Thomas Jefferson in 1784. He opened an Indian burial mound near his Virginia home, accurately recorded the position of the strata and their contents, and came to several valid conclusions concerning the function and age of the mound.

But this was the exception. The rule--if and where digging took place--was haphazard, clumsy exploration with material removed from context, hopelessly unidentifiable in many cases. Only in the past hundred years has archeology emerged from the level of treasure hunting and grave-pillaging to one of the recognized sciences.

Field archeology is the use of scientific methods for excavating ancient materials. It assumes that the historical importance of an object depends more on its associations than on its nature or material value. Scientific excavation alone can determine these associations.

The casual digger, and sometimes the thief, are primarily interested only in the commercial or artistic worth of artifacts; the true archeologist values the knowledge associated with the find.

Objects found or stolen out of context can baffle even the expert. If a European farmer digs up a marble statue, sells it, and it passes from hand to hand, eventually ending up in a museum--yet nobody knows where it came from--it may still be a work of art, but its historical value has usually been lost. Scholars must guess its age and its place of origin, using known phases of art for comparison. If the experts do not agree, only confusion will result. Wooley says, "If the finding of an important object be incorrectly reported it becomes a positive stumbling block to science."

General Pitt-Rivers' excavations in Wessex laid the foundations of modern field archeology. He applied the evolutionary doctrine of complex organisms slowly developing from simple forms to the study of the human arts and technology. While tracing the development of the English service rifle, he came to believe that similar principles were relevant to the study of the technologies of mankind.

Lord Carnarvan and Howard Carter demonstrated the value of scientific methods in their uncovering of the tomb of King Tutankhamen in 1922. Their years of planning and research, their painstaking excavations and careful recording methods showed the world that archeology was a scientific discipline with a demanding technique, but one capable of producing stunning results.

The whole world thrilled to their work at the Egyptian tomb, and men began to realize that archeology was a subject of concern to everyone. Man's history in the Valley of the Kings was everyman's history. The golden objects, the articles of fabulous beauty and antiquity, (and some of shoddy workmanship), filled room after room at the Cairo Museum. People everywhere gloried in the discovery.

Archeology would never again belong solely to the wealthy patron and the idealistic searcher and hobbyist. Although scientific methods of digging had been slowly developing, they were known to only a few. Worldwide publicity accompanying this carefully planned excavation of the Tutankhamen burial allowed the fascinated newspaper reader to feel a real participation in the search. He saw that digging was not luck. The years of patient hard work of Carnarvon and Carter were made strikingly clear as new treasures were brought to light by the slow, tedious routines. The long years of excavation and recording actually served to point up the advantage of the scientific method over random digging and tomb robbery: this way both the antiquities and the knowledge were saved for mankind.

How Things Get Buried and Preserved

But people always ask, "Why dig? How did a whole city get buried in the first place? How did the mosaic pavements put down by the Romans come to be twenty-five to thirty feet beneath the streets of London?" We know graves were dug and their contents put there; but houses, streets and cities have not sunk beneath the earth's surface--the earth has risen above them. In fact it is happening all around us today. Wherever a place has been continuously occupied a slow process of buildup has occurred. Long ago, refuse was thrown in the streets; new cobbles were laid over the old rubbish and filth; the street level gradually rose, and one had to step down into the houses on either side. When an old house was torn down and rebuilt, the place would be filled in and the new floor set at or above street level; the first foundation would still remain underneath.

Over the centuries this process has been repeated in many areas of the world. When the huge skyscrapers of today go down into the earth, the workmen cut through layer after layer of a city's growth.

In the Near East the waste accumulates very rapidly. Mud brick is the common building material and walls are made thick. When they collapse they fill the rooms. Hauling away debris is expensive, so the usual procedure is to level the ruins and build on top of the rubble. In Syria and Iraq most villages are built on mounds of their own making; some of the ancient cities rise hundreds of feet above the plain; these cities are composed of superimposed house remains and partly collapsed walls. Such a place is Troy.

What about a Roman camp site? How could this get buried? Nature does it with vines, turf, and the buildup of soil by dust and wind. Centuries of decay and soil formation hide the leavings of the legionnaries.

Volcanic action has very rarely buried buildings, although this affords the best preservation. Woolley says, "It is with a green jealousy that the worker on other sites visits Pompeii and sees the marvellous preservation of its buildings, the houses standing up to the second floor, and the frescoes on the walls, and all the furniture and household objects still in their place. . . ."

Destruction of a city by fire or pillage is another way things get buried. Buildings have burned down on top of their contents; victorious armies have forced the defenders to flee, usually before they could gather up their possessions. However, plunderers generally did not take everything; neither did fire always make a clean sweep. Beneath the toppled walls and layer of ashes, much of the original city may remain. The contents may be found burned almost beyond recognition, but even charred fragments can help an archeologist reconstruct the culture.

So we see that things do get buried, and we shall discuss the ways archeologists go about finding out where to dig and how to go about it.

Locating and Surveying the Site

Generally speaking, an archeological site is an area that has been used by man. The terms site location and survey are used somewhat loosely and interchangeably by archeologists. Field survey is sometimes used to connote the generalized activities of site location; it is also used to indicate the preliminary investigation of a site by surface collections or test digs, and to identify the nature of the site. A topographic survey culminates in a precise preliminary map of the site.

Sites are discovered by chance or as the result of field survey. A spectacular chance find resulted when a group of four boys playing near Montignac, France, followed their ball and dog down a hole in the ground and found the famous Upper Paleolithic cave paintings of Lascaux.

London ditchdiggers sometimes have come upon Roman structures, and farmers the world over have unearthed fossils and artifacts. Since the last century, a number of accidental discoveries of sites have been made from airplanes. For example, forgotten Mayan pyramids, deep in jungle territory and all but obscured by vegetation, have occasionally been sighted from the air.

A violent occurence in the form of the demolition of artillery ammunition during World War II opened a cave site near Palermo, Sicily.

Nature helps, too. Long-buried sites can be exposed by erosion. At Olduvia gorge in Kenya, East Africa, some of the earliest physical and cultural remains of man were uncovered by nature. When a water level recedes, occasionally an archeological deposit will come into view. A tidal wave has revealed such a site in the Marquesas Islands.

Although most sites have been discovered by sheer luck, many archeologists first decide what they want to find, and then go about it in a scientific manner. This directed, purposeful search is becoming increasingly important. For example, Eugene DuBois went to Java for the specific purpose of locating an early man site, and he found Java Man.

Knowledge of the habits and preferences of the group he is investigating may suggest to the archeologist where to look. Occasionally maps show the location of mounds or villages sites. Local residents often know where someone has found pottery, arrowheads, or other artifacts. A regional nickname or some distinctive geographical feature may give a clue to its former use and users.

After the site has been located, certain steps are necessary before an archeologist can begin work. A field excavation will be planned, and it usually requires additional research. This may involve a thorough study of all documents, legends, and reports of finds of other archeologists working in similar areas.

In any event, permission of the owner must be obtained before a search is begun. A formal permit from the government may be necessary; many countries have strict laws regulating archeological work, especially the removal of artifacts from the country. Sometimes governmental supervision is required before a field survey can be made.

Three main factors influence the method chosen for a survey and the manner in which it can be carried out: (1) the resources of excavation: time, labor, and materials available; (2) the kind of site being sought; (3) the vegetation and other natural environment of the area.

An example will show how these factors can affect a survey. Betty J. Meggars and Clifford Evans, searching for sites in British Guiana, were unable to finish their work during the dry season. There were few men for hire in the thinly populated area; neither could men, materials, or food be imported because of poor transportational facilities. In fact, the archeologists themselves traveled largely on foot, with some relief from truck, tractor, bullock cart, and dugout boats. They hung their hammocks in abandoned thatched huts, cattle outstations, or occasionally in the house of a resident priest. Corned beef, rice, and army C-rations were their staple food, unless some friendly rancher invited them for a meal. A small kerosene primus stove was used for cooking.

The jungle of tightly interwoven growth made travel difficult and hampered excavation. In the rainy season, rain and humidity not only made field work unpleasant, but threatened to ruin sample specimens and equipment. The archeologists found that most of the sites contained few artifacts because vegetative matter and bone were destroyed by the moist conditions; usually only a few stone objects and soil discolorations remained--difficult to locate and identify.

However, under these trying conditions they managed to find guides and continued with the survey until thirty sites were investigated.

Aerial photography is a valuable survey tool because topographical features are often more easily recognized from a distance. Soil color variations and changes in either the type of plant material or plant growth rate may suggest human alteration of the soil. Buried walls can limit the percolation of water and cause a less well-developed crop. The digging of a grave causes soil to be deeply mixed; a different vegetation or a more luxuriant growth may occur above the grave. If vegetational cover is absent, the burial sometimes will have a soil color different from its surroundings.

All of these surface signs can help to guide the digger, and in many cases such features are apparent only from the air.

Occasionally, preliminary surveying by car is effective--especially in the case of large mounds--but less impressive sites nearly always call for a systematic search on foot. In fact, all sites are finally inspected in this way: the party usually forms a line, walks slowly across the area, and records any artifacts or unnatural characteristics of the landscape. Surface collections are then made and identifying photographs taken.

Once a site is located, it need not always be worked immediately. Sites that are in the paths of proposed roads, bridges or dams are usually given priority over others. This salvage archeology must often be carried out rapidly; sometimes only a portion of the site can be examined in the alloted time.

Type of Sites

Sites are classified according to location, use, or historical context.

Site Locations. Site locations are designated by terms that include: caves, frozen sites, desert sites, underwater locations, jungle sites, and open areas. Preservation varies with the type of site and with the local conditions. Few bones or vegetable remains can last unless the area is very dry. For example, in the damp southeastern part of the United States, only pottery, stone, and a little bone are customarily found. However, in the southwestern United States and other dry areas of the world, not only pottery, stone, and bone, but other, more perishable organic materials often remain.

Cave sites provide somewhat better-than-average chances for preservation. Lovelock Cave, Nevada, is an example of a dry cave site. Among the items that have been recovered there and from similarly favorable dry locations are: yarn, textiles, dried fishes seeds, string, snares, sandals, matting, cane arrows, bone awls, obsidian arrow points, shell beads, and digging sticks. Excavation of Belt Cave in Iran has produced pottery, flint blades and scrapers, a human skeleton, and the bones of ox, pig, sheep, goat, and gazelle.

Deposits found in wet caves and those under rock shelters usually have suffered from water damage, and the finds are limited.

Continually frozen sites, while rare, offer excellent preservation. In the Altai Mountains of Russia, the tomb of a nomadic chief was found frozen as a solid block of ice. The tomb was "excavated" by pouring boiling water on the ice. Besides the tattooed body of the chief and women in log coffins, there were: carpets, embroideries, appliqued felt, wood carvings, a cart and a yoke for oxen. In addition, the workers found ten yellow mares with perfectly preserved skin, hair, and muscles; their saddles and trappings were intact, and their entrails even contained undigested food. The scientists thought that valuable objects of gold and silver probably had been buried with the chief, but all signs pointed to the entrance of grave robbers shortly after burial, allowing the tomb to fill with water and freeze.

In arctic North America where permafrost is present, early Indian sites have been explored by removing the melted top layer and letting the frozen ground beneath it melt. The exposed portion is excavated as soon as it softens. Preservation under these conditions can be very good if newly thawed material is removed before decay takes place. In such sites baleen knives, wooden buckets, kayaks, boats, harpoons, arrow tips, arrow shafts, feathers, and shells have been uncovered.

Desert sites, whether located in open areas or caves, afford good preservation. Natural desiccation (drying) takes place, and the lack of moisture prevents decay. Some of the best preserved artifacts have come from desert sites. Egyptian tombs, like that of Tutankhamen, Basketmaker Caves in the southwestern United States, those in Inner Asia, such as the Khotan settlement and the documents as Niya--all have proved important finds. Many burials along the arid coast of central and southern Peru have yielded organic materials; in some cases it has been possible to study details of clothing and even intricacies of hair style.

Underwater sites, including bogs, vary in preservation qualities according to the oxygen content of the water and other local conditions. Some good preservations have been found in English peat bogs; others have been retrieved in the Alpine lakes region. By examining surviving organic materials from the ancient lakes, searchers have learned much about Neolithic and Bronze objects, basketry, linen textiles, and food have been recovered. Scientists were able to reconstruct the life of the Star Carr people who lived in Yorkshire, England, 9,000 to 10,000 years ago on the edge of an old lake bed, which is now a bog. Quantities of various animal bones, as well as horn, stone, and wooden objects, remained to tell us about the culture of these early people.

In a sacrificial area in Yucatan, incense, human skeletons, and hundreds of smaller articles were discovered at the bottom of a well. Bits of fabric, darts and dart throwers were brought up; workers also found numerous symbolic figures carved out of jade or beaten on copper or gold.

Occasionally an ancient sunken ship will be sighted by a sponge diver or other underwater explorer. One such ship was discovered in a tell (mound) in the Mediterranean Sea. Inside the mound was the vessel, which had set sail in 200 B. C., carrying pottery, statuary of marble and bronze, and even some unfinished columns. The fine mud that enveloped the boat acted as a preservative.

Aqualung skin diving, especially the improved technique of the past few decades, has extended the scope of underwater archeological exploration.

Jungle sites and tropical rain forests offer very poor preservation because of the heavy precipitation and active vegetational growth. Under these conditions, wood and vegetable matter decay; secondary growth invades the site in about five years; bone material disintegrates, and only a few pottery fragments and stone objects survive. Many of the Mayan and Cambodian stone edifices have been torn apart by root growth.

Function or Use. Sites are also classified according to their functions, or the uses to which they were put. They can generally be categorized as follows: Habitations, ceremonial sites, burial sites, quarries, painting sites, animal killing sites, and stone chipping stations. But some sites show evidence of having served more than one function; the true nature of a multi-purpose site usually cannot be determined until the objects have been recovered and analyzed.

A place where people once lived is called a habitation site. These may be found in any climatic locality, in caves, in open areas, river bottoms, or mountain valleys. One of the most famous habitation sites in the Old World is the amazingly well-preserved city of Pompeii. In A. D. 79 the city was buried by the eruption of Mount Vesuvius, and was not unearthed until the eighteenth century; archeologists have uncovered baths, taverns, and private dwellings complete with their contents. The work on Pompeii is still in progress.

Other well-known Old World habitation sites are Herculaneum (also buried by Vesuvius), Jericho, Knossos, Mycenae, Troy, Babylon, and Ur--each of them a colorful chapter in archeology.

New World habitation sites include Pueblo communities and Maya, Inca, and Aztec cities. Innumerable camp sites of various ages occur in most countries, and the greater number of them remain undiscovered or unexcavated.

Some areas or buildings served only ceremonial functions. Certain Greek temples immediately come to mind, but Rock Eagle, Georgia, also falls into this category. Rock Eagle is literally a pile of rocks in the shape of an eagle, and the local Indians used it for ceremonial purposes.

Much of the most informative archeological material comes from burial sites. The practice of burial was probably first begun in the Middle Paleolithic. Burials are composite (many individuals) or single; they range all the way from a shallow hole to the elaborate Egyptian tombs.

Many Viking burials have come to light. Early in this century the hermetically sealed burial tumulus (mound) of a Viking queen was discovered at Oseberg, Norway. Its date was placed at A. D. 850. The equipment of this tomb is in striking contrast to other plain monuments in its district. By digging down into the burial ship that held the body of the queen and a companion, excavators found fragments of a wide assortment of objects: furniture, utensils, ornaments, a carriage, sledges, horses, dogs, and tent frames. Some of the grave goods had been crushed as a result of the gradual settling of the mound extensive restoration and elaborate preservation of most of the objects was necessary, not only to prevent disintegration of frying out in the air, but because the damage to the material over the centuries had been so great.

One of the functions of the Indian mounds in the southeastern United States was burial. As was the case of the Virginia mound excavated by Thomas Jefferson, such structures were built up in layers over long periods of time. Bones of the dead were periodically gathered up and placed on top of the elevation; another layer of dirt was added over the bones; the process was repeated over the centuries. Sometimes these burial mounds rose to heights of more than fifty feet; they were usually crowned with a temple, which could be approached by a broad ramp of log or earthern steps.

There are many Indian mounds of different shapes throughout the southeastern United States and the Mississippi Valley; some are shaped like animals, others like circles or squares. Usually, such structures functioned as both burial and ceremonial sites.

Quarry sites are usually found where outcroppings of suitable types of rock occurred. Archeologists look for stone chipping stations in the general vicinity of the quarry. However, it is rare for either of these two sites to furnish enough of interest to make excavation worth while. Likewise, animal kill sites produce only scant information other than the type of animals sought, possibly the method of hunting and butchering, and the weapons that were used.

Several paleolithic painting sites have been discovered in the limestone caves of France and Spain (Lascaux, Trois Freres, Altamira, La Mouthe, Tuc d'Audoubert). Here Paleolithic man painted and engraved images of the animals that he hunted. Three schoolboys discovered two of the above caves. Floating up a subterranean river, which they had previously explored with their father, they chanced upon drawings of bison, reindeer and horses, as well as a pair of clay bison statues. Two years later the same three boys descended a natural well and found paintings in another cave which is named for them, Trois Freres (Three Brothers).

Such cave pictures are most often located in dark recesses where early men would have needed artificial light. The paintings are often placed on inaccessible areas of the walls. Animals are the dominant motif. Spears are often depicted, but very few men are included. Scientists have deduced from the position of the paintings and the subjects drawn that the paintings may have been part of a magic ceremony or religious belief of these early men.

Painting sites in the southwestern United States show a variety of animals such as mountain sheep and antelope.

Historical Context. In purely prehistoric sites there is no written record left by the people in question or by others who were in contact with them. The only source of data is the site itself. However, history may be an important adjunct to the information found or inferred during the excavation of later or historic sites.

Historic sites fall into three broad classes: Ancient historical sites, contact sites, and Modern Western European sites. Ancient historical sites were inhabited by people who possessed a system of writing and left written records. These records are often highly useful for dating and evaluating excavated material. The Egyptians, Aztecs and Romans were among the peoples who had writing and record systems.

Sometimes archeologists are seeking to add to what is found in known historical accounts. The digs at Jamestown, Williamsburg, and Fort Frederica are cases in point. So were Schliemann's attempts to verify the historical and legendary accounts of Troy.

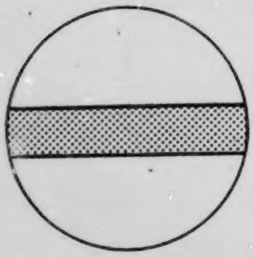
In the past, classical archeology has dealt primarily with the early Mediterranean higher civilizations that used writing systems. Lacking writing, the people who lived in contact sites could leave no written records of their own. Therefore, to interpret their customs the scholars and scientists are largely dependent upon the written records of the groups with whom such people associated: the Romans reported much about the ancient Gauls; early Spanish documents from the New World sometimes shed light on archeological finds. Finally, the presence of certain trade goods may point to contact with the inhabitants of a site.

The Excavation

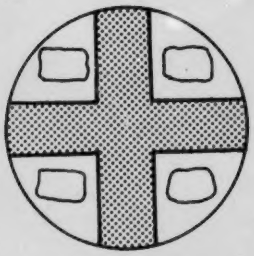
Some general procedures are followed in all scientifically conducted excavations: the area of the dig is kept neat and orderly; data pegs and reference strings accurately outline the areas that are to be excavated, thus providing ready reference points for the plotting of horizontal and vertical positions of all the artifacts that are recovered.

Wherever feasible, the walls of the dig will be vertical. In areas having sandy soil or heavy rainfall, the walls are usually stepped (like stair steps) to avoid cave-ins.

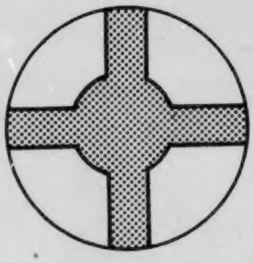
Methods. Usual methods of excavation include trenching, digging a pit or system of pits, working one or more quadrants, a combination of these methods, or total excavation. The trenching method is usually employed when deposits are very deep, if determination of the stratigraphy (sequence of strata) is the primary objective, or if the time is limited. Experts disagree concerning how representative a trench may be, for it is true that with this method an important area of the site could be missed completely. However, by increasing the number of trenches and adding several test pits the archeologist will lessen his chances of overlooking important information. When a specific area of similar sites is known to contain valuable material, this area is customarily excavated at the same time.



Simple trench.

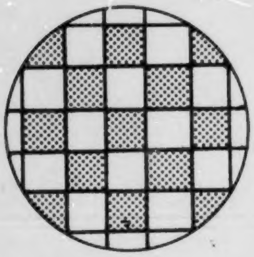


Trenches and pits.

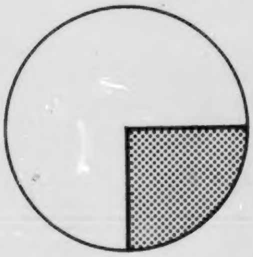


Trenches and center.

A checkerboard system of pits is sometimes used to work a shallow site. The entire area is laid off into five- or ten-foot squares. Alternate squares are then excavated. This method decreases the chance of missing larger important areas, because more squares may be dug if part of an important find is discovered. While this method gives a more representative sample, it is also more time-consuming than trenching.

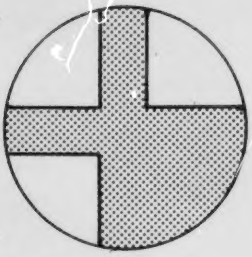


Checkerboard of pits.

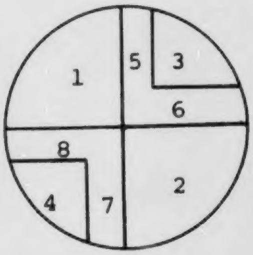


Quadrant.

Another method involves the excavation of a quadrant (one-fourth) of the area. A quadrant is thought to provide an average sample. Other quadrants may also be excavated, and trenches may be added to the quadrant for more complete coverage.



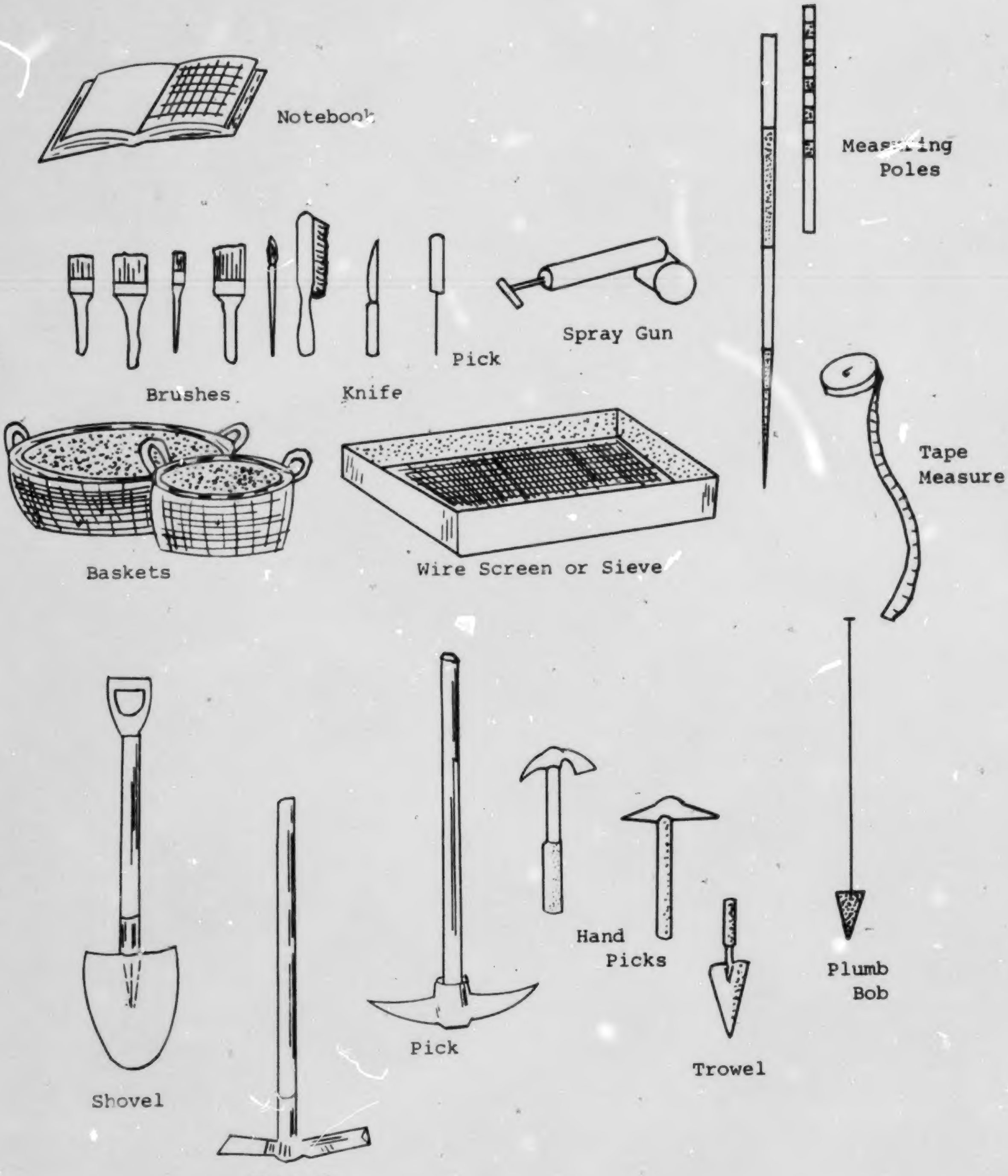
Quadrant and trenches.



Total excavation showing parts removed beginning with number 1.

Total excavation of a site provides the most complete record. This technique is usually recommended for the unusual site containing many artifacts; however, some authorities question the advisability of total excavation of rare and unusual sites. They point out that with the advances in the means of dating materials and with the ever improving techniques of excavation, a more complete evaluation might be done at some future date.

TOOLS USED FOR EXCAVATING


Notebook
Measuring Poles
Brushes
Knife
Pick
Spray Gun
Tape Measure
Baskets
Wire Screen or Sieve
Shovel
Mattock
Pick
Hand Picks
Trowel
Plumb Bob

Tools. Broadly speaking, an archeologist's tools are any implements that seem to do the job. Bulldozers have been used to remove unwanted dirt from the tops of deeply buried sites. Picks, shovels, and mattocks are employed where more care is needed, and trowels (brick laying type) are useful for finer work.

Removal of dirt from within the site requires much care to prevent the loss or disruption of valuable objects. Wheelbarrows are useful for carrying the dirt from the site to a place where it can be sifted and subsequently dumped. In some parts of the world, such as India, the workers use baskets for hauling the dirt; baskets are sometimes easier to obtain and some workers prefer them. A set of screens is necessary to break up the dirt for inspection; the dirt is screened through finer and finer meshes before it is finally discarded. Though this is one of the dirtier jobs at a dig, it is nonetheless important. Occasionally a small object, otherwise overlooked, will be the key to correlating strata in different sites.

For finer work, an array of miscellaneous implement--tongue depressers, dentists' probes, ice picks, paint brushes, whisk brushes, and insect spray guns--are used to remove dirt next to a valuable artifact. Tape measures and surveying instruments are necessary because the removal of an object from a site without knowing exactly where it came from can render it useless. Notebook and pencil for record keeping are most important and a camera can be of great help at all stages of the work. Important features are nearly always photographed as soon as they are uncovered because a sudden rain or cave-in could result in the loss of excellent detail.

Personnel. The personnel of a scientifically planned excavation includes at least one archeologist who is familiar with the type of work being undertaken. Trained diggers are needed. Because of their experience they will notice features sometimes overlooked. A few expert diggers can even tell whether their shovels are striking an object of fired clay, bone, or stone. Whenever something is hit, a skilled digger will call the archeologist. Further excavation then proceeds by more delicate and careful means.

Wages paid diggers vary with the country or state in which the site is located and with the type of material being found. Where gold and silver coins or artifacts are present, either a close watch by a supervisor, or a bonus system will be employed. If they have the opportunity, unscrupulous private collectors will try to buy interesting bowls, figures, paintings and the like from workmen. In some countries, India, for example, groups of people have been associated with digs for such a long period of time that the digger occupation is even established in the family. Throughout most of the world, though, workers have to be trained on the spot.

Records. Clear valid information can be obtained only if the excavation is neat and the records are systematic and detailed. The records consist of sketches, photographs, maps, field notes, and sample artifacts.

It is important that the exact, measured position (horizontal and vertical) where an artifact is found be recorded. For cataloging purposes, each artifact will be given a letter-number combination which designates its location. This identification is entered in the field notebook and printed on the artifact with an appropriate ink. The labeled artifact is then stored, either at the dig or at the operations headquarters, to await further examination.

As the dig progresses, all changes or variations in soil texture, content or color are listed in detail; a slight soil color variation may be the only remains of a former artifact. The object has decayed but a mold filled with a different kind of soil, or soil discoloration, may outline the original form. These vague and tenuous indication of sites or objects are often referred to as "ghost" sites, or "ghost" objects. If the signs are read properly, certain accurate deductions can be made from the circumstantial evidence of the destroyed site or object. Keen perceptivity and extreme patience on the part of the excavator are the qualities that must enter into this kind of detective work.

Old World "ghost" sites include a Bronze Age skeleton from Holland and post holes of an early Iron Age house in Jutland, both of which appeared only as soil discolorations. The identity of an Anglo-Saxon ship, Sutton-Hoo, found at Suffolk, England, was deduced from the placement of the iron spikes. Pompeii is another example: the bodies of the Pompeiians were covered with ash; rain or condensed steam turned the ash to mud which hardened around the bodies. Disintegration of the bodies left hollow molds of the victims' final postures. Excavators, by pouring plaster into these molds, can reconstruct lifelike replicas.

New World "ghost" sites include post holes of Indian houses found at Etowah Mound in Georgia and a burial at La Venta, Mexico--both evident only from soil discolorations.

Photographs of exposed artifacts in context, and photographs of the excavation itself, are invaluable for a clear record of the work. To obtain this documentary evidence, the area being photographed is prepared beforehand by the removal of all loose dirt from sides and walls of the dig. Strata differentiation can be accentuated by roughing areas of textural differences or by applying water mist to highlight certain changes. Natural shadows sometimes help. All such photographs need a scale; a measuring stick marked in one-foot lengths, or a person standing nearby offer good comparison. Labels identifying what has been photographed are a necessity.

Data for map-making is usually gathered, with natural topographic contours plotted on one map and exact locations of all excavated areas marked on another.

The amount of detail recorded will depend both on the archeologist and on the type of site. It is far better to have too much information than too little. Observations seemingly unimportant at the time of excavation may later prove to be the key to an unresolved problem.

Completion. After the work of digging and recording is completed, refilling the excavation may be necessary. Property owners usually stipulate such refilling as a prerequisite for permission to dig. The dirt is replaced with shovels or by any other convenient method. As a courtesy to future archeologists, recently dated coins (pennies) or other objects are usually mixed into the fill to indicate that excavation has taken place.

The owners of the multiple mound site at Etowah, Georgia required that the excavators restore the mounds to their original shape when the digging is completed. (Work is still in progress).

Dating Methods

The age of an object or of a site is a primary question for the archeologist. There are two major categories of dating methods, relative and absolute. Relative dating methods do not specify which year, but indicate whether an object or site is older, of the same age, or more recent than another. Absolute dating methods give a more or less fixed year, such as A.D. 1000. A relative date sometimes leads to an absolute date.

Relative. Relative dating methods include stratigraphy, seriation, use of past flora and fauna, and geologic relationships. Although relative dating methods provide less precise dates, they can be of great value: the stratigraphic position of an object may tell its age in relation to objects in other strata. The upper strata in a stratigraphic series are considered later than lower strata. Care must be exercised, however, to recognize bones or objects that may have been buried from a higher level. In the Sandia Cave excavation mentioned earlier, the Folsom Culture, because of its higher stratigraphic position, is thought to be more recent than the Sandia Culture material; the amount of time which elapsed between the two levels cannot be definitely measured. In the Belt Cave excavation, also named above, the number and percentages of various animal bones in the different layers indicated the climate at that time as well as food preferences of Belt Cave's occupants.

A systematic change in forms of arrowheads, pottery, and other items has been described in many areas. Seriation involves recognizing that a particular artifact fits in a certain place within an established sequence, organized on the basis of variations in color, size, or shape. New excavation sites often can be given a relative date by matching fragments of pottery found with a known sequence for the area. For example, the following pottery sequence is found in Northeastern Arizona:

Culture	Approximate dates	Name	Description
Pueblo IV	A.D. 1300-1700	Fourmile Polychrome	Black and white design inside and outside on red clay bowl.
Late Pueblo III	about A.D. 1200	Pinedale Polychrome	Black inside, black and white outside design on red clay bowl.
Early Pueblo III	about A.D. 1100	Saint John's Polychrome	Black inside, and white outside design on red clay bowl.
Late Pueblo II	about A.D. 1000	Wingate Black and Red	Black on inside of a red clay bowl.

In most cases, pottery types and styles show development from the simple to the more complex. However, the possiblility of a deterioration of techniques and elaboration must always be considered. There are the further possibilities that some groups used two or more different pottery types at the same time, or that two entirely different groups used the same type of pottery at widely spaced intervals.

In time, the plant and animal life within a particular area change. If the archeologist is familiar with the plant and animal history of that area, the discovery of animal bones or plant remains at a site may offer a clue to its age. One of the early man sites in the southwestern United States was discovered when a cowboy saw large bones protruding from an arroyo (gully) near Folsom, New Mexico. The bones proved to belong to a bison-like animal, extinct since tha last Ice Age. The spear points and the man who made them are now known as Folsom points and Folsom man, respectively. Fauna differences in the Mount Carmel caves of Palestine provide valuable insight into Pleistocene climate of that area. The gazelle, a steppe animal, and the fallow deer, a woodland animal, were found in different strata of the cave.

Knowledge of the geologic history of a region can be **helpful** to the archeologist. Dates of habitation sites can often be determined by correlation with the known dates of fluctuations in sea level, disappearance of lakes or swamps, periods of volcanic activity, and other geologic events. Recognition of these features in buried strata also helps the scientist to understand how the people lived, even though the present surface environment of the site may be much different. The migration of prehistoric people were more easily traced when features belonging to glacial and interglacial stages were understood. During the glacial periods, the climate became colder. With tremendous amounts of ice covering a large araa, the sea level became from 300 to 600 feet lower, exposing areas which are now covered by water.

Absolute. Absolute dating methods include calendrical dating, dendrochronology, potassium-argon dating, and the very important Carbon 14 dating.

The calendrical dating system involves the use of dated coins, dated building corner stones, or articles known to have been available for only a brief period of time. Some difficulty may arise in correlating these dates with dates on our calendrical system. Many Mayan buildings have dates inscribed on them, yet we are uncertain exactly when they were built according to our calendar. Ancient Roman coins are often dated, as are many Egyptian, Roman, and Greek edifices.

Dendrochronology, or tree ring dating, can be applied to certain types of wood or charcoal. Dendrochronology is based on the variation in size of a tree's annual rings; this is caused by climatic variations such as wet and dry seasons or length of the growing season. A tree from the Southwest can be dated if it has lived in a marginal area away from a constant source of water. By comparing the rings with an established sequence of dated rings, the date of the specimen can be determined.

Tree ring sequences are being developed for other areas of the world, but at present dendrochronology is particularly useful in the southwestern United States where the sequence extends back as far as 3,200 years. However, the poles used as rafters in puebloes can date only when the tree lived, and may or may not date the site in which they were found, because older wood was often salvaged for later construction.

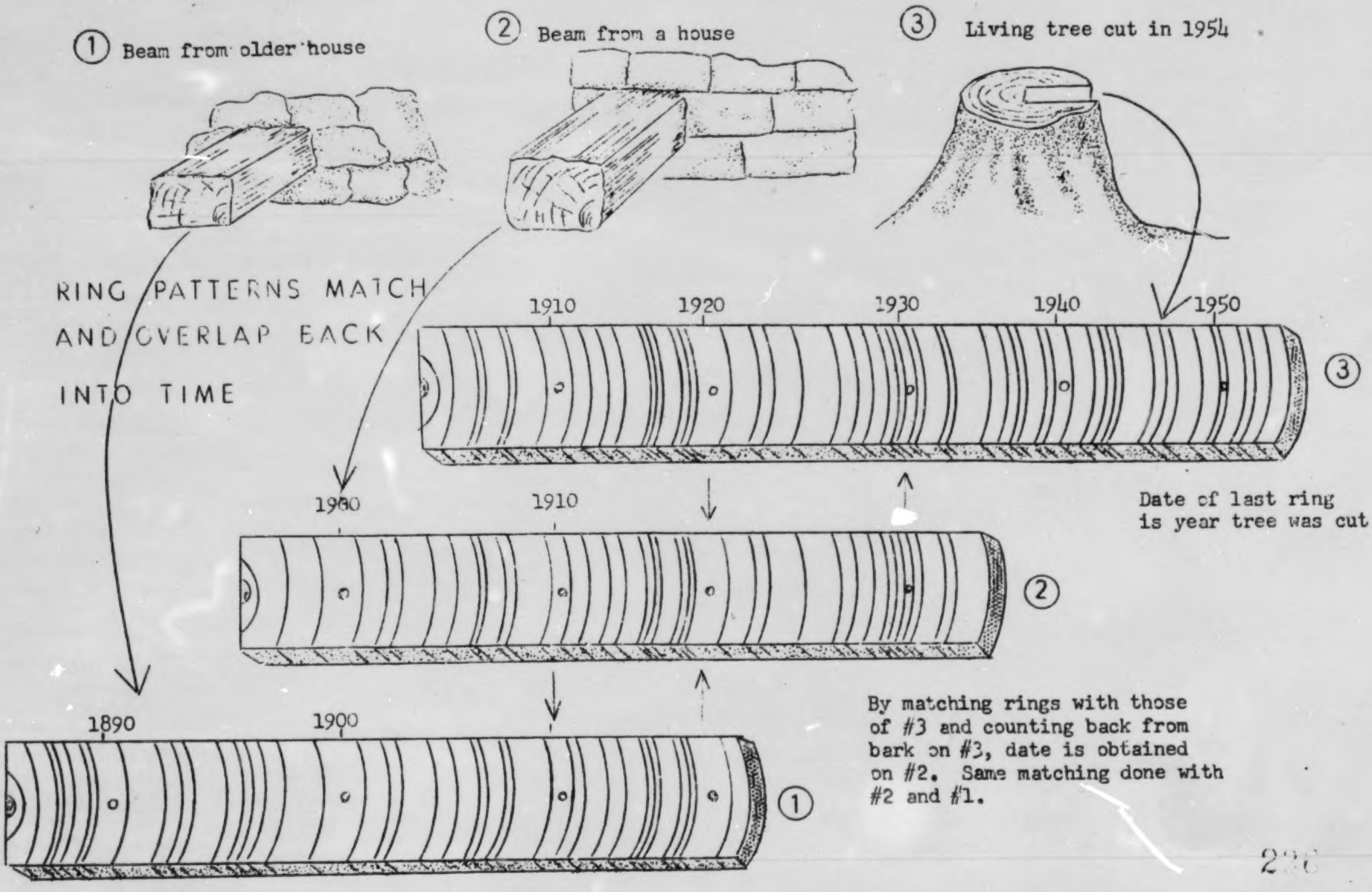
The potassium-argon dating technique can be applied to very old deposits that contain potassium. Over millions of years, potassium decays into argon at a regular rate. By measuring the amount of potassium and argon present, the age of a rock can sometimes be determined. A major difficulty with the method is that it cannot be applied to rocks less than about a million years old.

Recently, the Australopithecus find discovered in Africa by L. S. B. Leakey has been dated at approximately 1,750,000 B. C. by the potassium-argon method.

Carbon 14 is by far the most widely used absolute dating method in the field of archeology. It can be applied to any organic material in sufficient quantity for analysis. Carbon 14 is a radioactive isotope of carbon. This isotope, along with regular carbon, is taken in by plants and animals during their life. When a plant or animal dies, the radioactive carbon is no longer replenished and it disintegrates at a constant rate, one-half the quantity about every 5730 ± 40 years. The radioactivity of a sample becomes weaker and weaker as time passes; and after about 60,000 to 70,000 years, the amount of radioactivity is too small to measure--thus, samples older than this cannot be dated. All Carbon 14 dates are followed by a "plus or minus" figure to allow for inherent error in the technique. This error of measurement generally increases with the age of the article.

In 1965, twenty-eight institutions in the United States and thirty-eight institutions outside the United States had the equipment, the trained

DENDROCHRONOLOGY - TREE RING DATING


① Beam from older house
② Beam from a house
③ Living tree cut in 1954
RING PATTERNS MATCH
AND OVERLAP BACK
INTO TIME
1910
1920
1930
1940
1950
③
1900
1910
②
1890
1900
①

Date of last ring is year tree was cut

By matching rings with those of #3 and counting back from bark on #3, date is obtained on #2. Same matching done with #2 and #1.

personnel, and were actively engaged in Carbon 14 analysis. The dates of all samples so evaluated are published in a yearly volume called Radiocarbon. The ages of thousands of specimens from the United States along have been determined. Sandals found in a cave near Newberry Crater, Oregon, have been dated at about 7,000 years B. C. Charred sheep dung and charcoal from fire pits in Danger Cave, Oregon, date about 9,000 B. C. A barbecue pit and roasted animal food found in Russell Cave, Alabama, were used 9,000 years ago according to Carbon 14 analysis. In the Old World, charcoal found in a barbecue pit in Lascaux Cave proved it was in use 15,000 years ago. Stonehenge, in England, has been dated from 3,500-year-old charcoal samples found in a pit. Carbon 14 tests run on the linen in which the Dead Sea scrolls were wrapped dated it as being about A. D. 40.

Laboratory Investigation

If a sufficiently large crew is available, laboratory work may be carried out simultaneously with excavation; artifacts are immediately sent to the laboratory where they are cleaned, treated with preservatives and restored. Trained personnel frequently perform near-miracles of restoration: a Saxon helmet can emerge from scores of small fragments of decayed metal; hundreds of tiny wooden pieces could add up to a **shield**; a vase may grow out of bits of pottery; even a harp has been reconstructed when only the string nails and a slight soil discoloration remained.

Timing is important in this kind of laboratory work. Wood, bone, and many other substances usually need to be treated immediately after excavation so they will not shrink or disintegrate. Glycerin, formalin, creosote, alum, sterile water, or linseed oil with carbolineum, may help preserve damp or wet wooden objects. Bones are sometimes treated with diluted polyvinyl acetate, methylated spirits, diluted shellac, or other preservatives.

Frequently, much of the evaluation and interpretation of the finds must be left for a later time. For every one week spent in the field, about six weeks must be spent in evaluating, interpreting and preparing the material for publication.

Interpretation of all the assembled date is the archeologist's most difficult but important task. Even the smallest recorded detail could prove invaluable. In most instances, only a limited part of the culture will ever be known. However, some culture traits can be inferred from the excavated material. If quantities of broken pottery are found, the group had pottery. It is between these two extremes--few details or many--that the archeologist's training is most valuable. It enables him to recognize subtle bits of evidence; from them the economic structure, social organization, and many other aspects of a culture can sometimes be reconstructed.

The archeologist must begin his interpretation with the artifacts that have been recovered, and climate, both present and past, has a great influence on the type of artifacts that have lasted. Moist warm climates increase bacterial action, foliage growth and leaching of the soil. Cold dry climates tend to hinder disintegration. The kind of material of which the artifact was originally fashioned will also influence its chances of preservation. Textiles and woven articles disintegrate rapidly; so do most wood and iron objects. On the other hand, stone, glass, and gold objects, because of their durable qualities, are often preserved. It is no coincidence that stone tools are the basis and primary source of the "traditions" of the Lower, Middle, and Upper Stone Age.

Complete interpretation of the excavation data involves (1) placing the site in time, (2) evaluating it in relation to other sites and cultures, (3) describing the life of the people.

Historical placement of the site can usually be done by one or more of the dating methods. The establishment of relationships to other cultural groups is often more tenuous, but can sometimes be done. For example, molded copper bells have been found among the early Indians of Arizona although these Indians had no knowledge of the smelting process. Metallurgical analysis showed that they were smelted in Mexico. The archeologist might therefore deduce that primary (direct) or secondary (indirect) contact was maintained between these two groups, and the bells in question were probably acquired by trade. In such instances, similarities of style as well as geographic proximity must be considered. Similar copper bells might even be common in Inner China, but a competent archeologist would be highly skeptical of the suggestion of cultural contact of the early Arizona Indians with Inner China.

If a specific excavation does not clearly place the site in time and clarify its relation to other cultures, future discoveries, coupled with present knowledge, may supply the missing pieces.

The secondary primary task, and most important goal of interpretation, is to describe the life of the people. Knowledge of the implements used by inhabitants provides information about economic activities. For instance, a great number of grinding stones were excavated at Mesa Verde, Colorado, and Jarmo, Iraq; the people were assumed to have relied heavily on grain crops. The absence of large quantities of animal bones would also substantiate such a reconstruction.

Close analysis of animal bones may make possible the differentiation of wild and domestic animals. Thus, whether a group were hunters or herders can often be learned. The size of a group, length of occupancy of a site, and population changes may also be approximated by using data such as size of the camping area, number of burials, such ecological factors as the number and type of plants and animals, and climate. An extensive knowledge of the findings of other digs and the cultures of neighboring groups may also be of value. A small fragment of woven material could tell the trained archeologist what the material was made of, how it was woven, and the kind of equipment used. The knowledge of implements, methods, and techniques of modern primitive peoples, may, if judiciously applied, give an indication of some of the aspects of the early people.

Publication

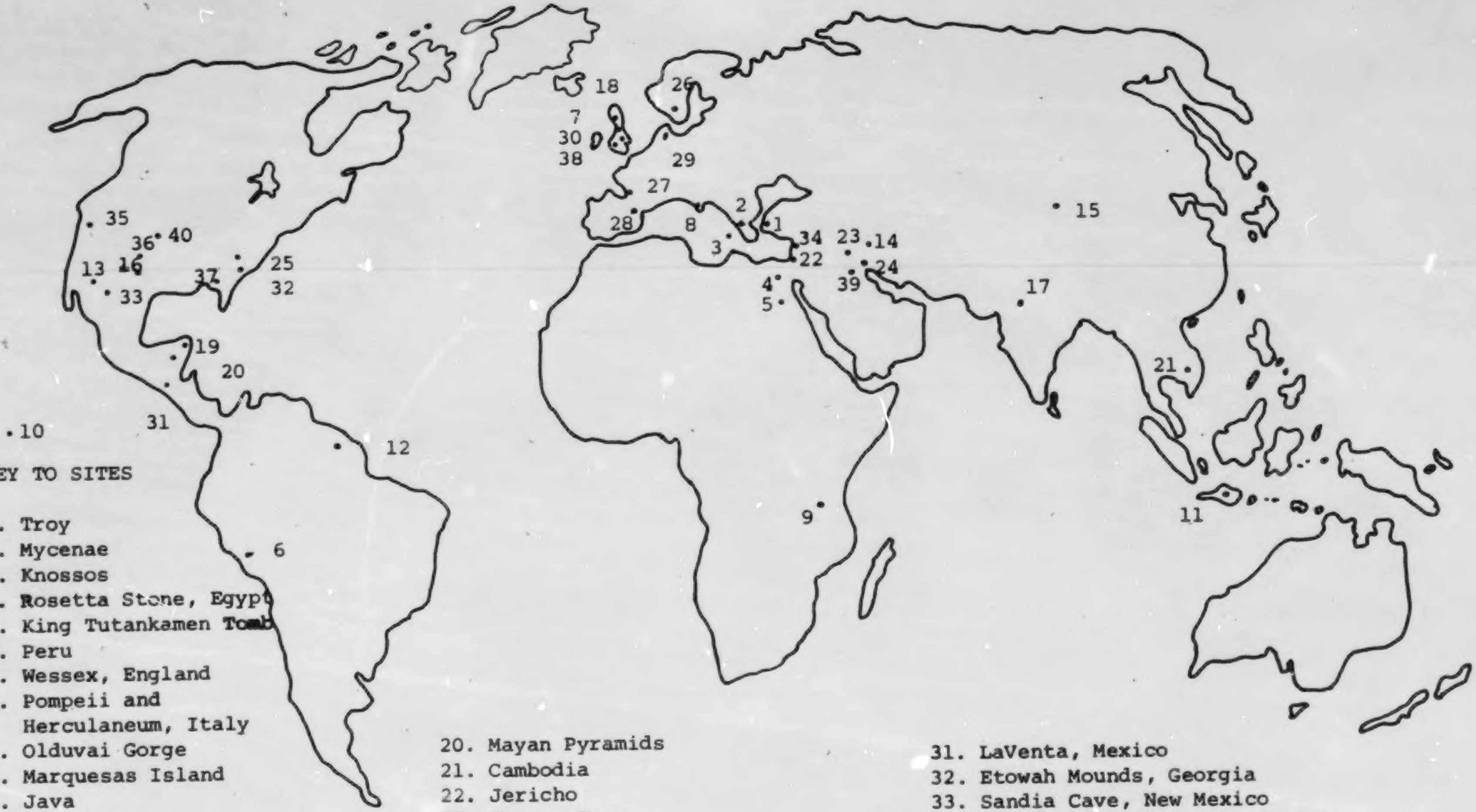
No matter how well conducted, an excavation can be lost to science unless it is adequately recorded and the results published. An unreported and unpublished excavation robs everyone of knowledge; sometimes this knowledge is irreplaceable. No one can successfully re-excavate a site; once explored, it is usually destroyed. Therefore, if an excavator does not publish his findings, probably no one else ever will.

A well written report is one that is easily understood. It customarily begins with a very short summary of the material and lists the main headings of each section. A systematic review and interpretation of new material usually follows. Other sections include a full statement of structural and stratigraphic evidence, a description and analysis of the finds, appendixes and index. Tables and pictures can help make the account clear and interesting.

Conclusion

The competent field archeologist takes the long view. He keeps in focus the continuum of human development even when he is analyzing its isolated bits and pieces from separate cultural deposits. His material is potsherds and bones, but in a sense he is a true historian: he makes the past live again. He knows that archeology is not a self-contained discipline but part of the wider study of man.

He must be able to observe critically and record accurately and objectively. He needs his scientific imagination, but as R. J. C. Atkinson has said, there is no place in archeology for intellectural partiality in the choice of facts.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KEY TO SITES

1. Troy
2. Mycenae
3. Knossos
4. Rosetta Stone, Egypt
5. King Tutankamen Tomb
6. Peru
7. Wessex, England
8. Pompeii and Herculaneum, Italy
9. Olduvai Gorge
10. Marquesas Island
11. Java
12. British Guiana
13. Lovelock Cave, Nevada
14. Belt Cave, Iran
15. Altai Mountains, USSR
16. Basketmaker Caves
17. Khotan
18. StarCarr, Yorkshire, England
19. Yucatan
20. Mayan Pyramids
21. Cambodia
22. Jericho
23. Jarmo, Iraq
24. Ur
25. Rock Eagle, Georgia
26. Oseberg, Norway
27. Lascaux Caves, France
28. Altamira Caves, Spain
29. Jutland, Denmark
30. Suffolk, England
31. LaVenta, Mexico
32. Etowah Mounds, Georgia
33. Sandia Cave, New Mexico
34. Mt. Carmel Caves, Palestine
35. Newberry Crater, Oregon
36. Danger Cave, Utah
37. Russell Cave, Alabama
38. Stonehenge, England
39. Babylon
40. Mesa Verda, Colorado

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EVOLUTION

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THE DEVELOPMENT OF MAN AND HIS CULTURE:

OLD WORLD PREHISTORY

Teacher Background Material

Grade Five

EVOLUTION

Evolution and Anthropology

Evolution is a subject which is usually studied in biology courses. Because it offers a scientific explanation for the origin and development of man, evolution is important to the student of anthropology.

Man is a living thing. Man is an animal. Man is a toolmaking animal and an animal with language. Anthropologists believe man acquired the capacity to make tools and to speak after he attained certain characteristics through biological evolution. After man acquired culture, biological adaptation became less important than cultural development. However, evolutionary processes still apply to man, although they are less important than in other animals.

Anthropologists study evolution, along with paleontologists, primatologists, and biologists. However, anthropologists are concerned with the relationship between biology and culture in the development of man.

Anthropology is the study of man. Two main divisions of anthropology are cultural anthropology and physical anthropology. Cultural anthropology is the study of man's culture; physical anthropology is the study of man as a member of the animal kingdom.

Man can be assigned to a place in the animal kingdom on the basis of physical characteristics. In spite of the similarities between man and other animals, it is obvious that man is unique. This uniqueness becomes apparent when it is observed that man is the only animal who makes tools and uses language. The development of speech and toolmaking are considered the best indicators of the origin of culture. These two events probably occurred over a million years ago. The origin and sequence may never be known, although the development of toolmaking can be traced by archeological methods.

Organic evolution is the development of a plant or animal, in the course of time, by a sequence of changes resulting from the adjustment of the organism to its environment. The term evolution, meaning simply change or development, has been applied to other patterns of change. Students of organic evolution would like for the term to apply only to processes of organic evolution. Confusion has resulted from attempts to attribute these processes to other types of change. In this paper the term evolution will mean organic evolution only.

Classification of Life

Numerous attempts at classification of plants and animals reveal man's continuing concern with his relationships to other living things. Classification (taxonomy) was developed because man lives in a world containing many things. Classification is merely a system for distinguishing among these things and placing them in some sort of groups in order that they may be more easily understood and studied.

Linnaeus and Modern Classification. Carolus von Linnaeus (1707-1778) is known as the father of modern classification. Linnaeus believed that each species of plant and animal was a distinct type unchanged from creation, and that his task in classifying life was to discover the ideal type for each species. On the basis of common or shared characteristics, he placed species into larger groups (genera, families, orders, classes, phyla, and kingdoms). Each organism was to be known by two names (binomial nomenclature): the genus as well as the species name. For example, man is known as Homo sapiens. Linnaeus did his work well; we use his basic system today. There have been some modifications, but Homo spaiens is still classified in the order Primate where Linnaeus placed him over 200 years ago.

The Species Problem. The problem of distinguishing between species has proven more difficult than Linnaeus envisioned. The species problem is and applied to a class, it should distinguish that class or group of things from all others. Species are groups. Classification is merely a systematic method of naming. In the higher animals, a species is that group of individuals having many characteristics in common, differing from all other groups in one or more ways, and able to breed with one another to produce fertile offspring which resemble the parents.

The problem of classification is that in nature there are no clear dividing lines between species. The nineteenth century biologists believed that for each species there was an ideal type which exhibited all the characteristics of the species. Biologists began to question this when they were unable to find these ideal types. Their findings indicated a gradation of characteristics within species and between different species. It is easy to distinguish between a cat and a canary, but it is much more difficult to separate the various groups of pigeons into species. It is even more difficult to separate groups of fossil remains, such as the remains of fossil man, into different species. Today, in spite of tremendous advances in biology, the problem of distinguishing species still exists.

Comparative Anatomy. Understanding of the similarities and differences between species was increased as advances were made in comparative anatomy. In the sixteenth century, biologists began to recognize the structural likenesses of parts of various animals. Dissection of human bodies was legalized and slowly became part of the medical curriculum. In the early 1800's Georges Cuvier published one of the first books in which the anatomy of various animals was compared. Prior to this time, the different animals had been studied separately. Following this development, comparative anatomy underwent rapid expansion, and made major contributions to the study of Paleontology.

Paleontology, the study of prehistoric life through fossil evidence, is shared by both biology and geology. The **credit** for making paleontology a distinct science is shared by the anatomist **Cuvier** and the geologist Smith.

William Smith (1769-1839) was a professional surveyor who developed a tremendous practical knowledge of the sedimentary rocks of England. He discovered that each layer of rock contained characteristic associations of fossils, and that by learning to recognize the fossils he could identify the rock strata. He also found that the bottom layers of rock were the oldest, that is, they were deposited earlier than the rocks covering them. This is called *superpositional stratigraphy*, a fundamental principle in paleontology, archeology, and geology.

Reconstruction of fossils has always been fundamental to paleontology. **Georges** Cuvier's skill in comparative anatomy allowed him to reconstruct vertebrate animals from fossil bones. Cuvier recognized that many of the animals he worked with were no longer living; he believed that they had been killed off by a series of catastrophes, and that new species had then been created to take their places. He assumed that between these catastrophes no changes occurred in animals. This was consistent with the popular belief of the time, that the world was only 6000 years old--a figure calculated from Biblical references by Archbishop James Ussher in A.D. 1650. Smith's principle of superpositional stratigraphy demanded some concept of geologic time, but changes as Cuvier saw them could have been compressed into any time scale.

Historical Geology

Hutton and Uniformitarianism. It remained for James Hutton (1726-1797), a Scottish physician, to establish the continuity of earth history. He watched the forces of wind and running water acting on the crust of the earth, and envisioned entire continents being washed into the sea by these forces acting continuously over long periods of time. From the fossil evidence of sea animals in high mountains and other observations, he inferred that rocks formed under the sea were later uplifted to form new land masses. To explain these physical changes he formulated the theory of uniformitarianism. According to this explanation, the forces now in operation on the earth were the same forces that had always operated on the earth; large changes, such as the uplifting of mountain masses, took place over long periods of time. Hutton had no place in his theory for the periods of stability, followed by catastrophic action, that dominated Cuvier's views.

Historical Geology and Evolution. The principles of superpositional stratigraphy and uniformitarianism laid the basis for modern historical geology. These principles were combined with other advances in geological knowledge in Sir Charles Lyell's important work, *The Principles of Geology*, the first volume of which was published in 1830. This work contained the synthesis of geologic evidence in support of the theory that the earth is very old and that the forces which shaped it are still in operation. It also dealt with the relationship between fossils and living animals. Charles Darwin carried a copy of *The Principles of Geology* with him on the famous voyage of the Beagle, during which he began to develop the ideas which subsequently led to his classic statement of evolution.

Development of Darwin's Theory of Natural Selection and Evolution

The Voyage of the Beagle. In 1831, the English ship *Beagle* began a five year voyage whose purpose was to survey and map South America and some of the Pacific Islands. During this time, Charles Darwin served as ship naturalist. Darwin had begun training as a medical student and later he transferred to Cambridge with thoughts of becoming a minister. On this voyage, his duties were to collect plants and animals and to keep a record of his observations. Darwin was familiar with the species problem as well as with most of the ideas in biology current at the time. His grandfather, Drasmus Darwin, and other students, had suspected that living species changed through time. However, they had failed to develop a theory which would convince others. Darwin was also interested in geology, and carried with him a copy of Lyell's book, *The Principles of Geology*.

As the *Beagle* proceeded southward along the east coast of South America, Darwin noticed a gradual change in the same animal species. He found fossils of extinct animals which were similar to the living armadillos of South America. Both these facts indicated that species were not fixed to one type, but might change from one geographic area or time to another. In the Andes mountains he gathered fossil shells and recognized that these mountains had been formed more recently than those of Europe.

The Galapagos. In September 1835, the *Beagle* arrived at the Galapagos Islands some 500 miles off the coast of Ecuador. Darwin had hoped to find more fossils here, and was disappointed to learn that the islands were of recent volcanic origin and contained no sedimentary rocks.

He was nevertheless impressed by the differences in the finches on the islands. All the Galapagos finches resembled the small ground finch of Ecuador, but on the various islands there was so much difference between them that they appeared to be different species. The Ecuador finch was a ground dweller which fed mainly on seeds. Of the fourteen different species of finches on the islands, some were insect eaters living in trees, some lived and fed on cactus, some were large ground dwellers, and one finch had become like a woodpecker and used a cactus thorn to probe insects from trees. The birds could be easily distinguished because the form of the beak in each species was fitted to that species' way of life. The question that now confronted Darwin was "Could all these finches have been derived from the Ecuador finch and changed through adaption to different ways of life?" Charles Darwin was to spend the rest of his life seeking the answer to this question and the resulting question: "How could this occur?"

Malthusian Principle. After returning to England, Darwin read Thomas Malthus' *An Essay on the Principle of Population as It Affects the Future Improvement of Mankind*. The Malthusian principle states that human population increases at a faster rate than food production and certain checks necessarily limit the human population. Malthus considered war, pestilence, and famine to be the checks. Darwin applied this Malthusian principle to the animals that he had studied. Reproduction in excess of the number that could survive was the key to the evolutionary process.

Variation and Natural Selection. Darwin knew that variation occurred in all animal species--all the individuals of a species differed in some ways. Since each species reproduced more individuals than could live to reproduce, some must die before reproducing. The organisms that survive and leave offspring are those best adapted to their environment. Also, the organisms that are not as well adapted to their environment are less likely to produce descendants. This principle, called natural selection, helped explain why species differed from each other and from their remote ancestors. Since descendants generally resemble their parents, future generations would tend to be more like those parent organisms that had survived.

A Theory of Evolution. Variation and natural selection were the keys that allowed Darwin to formulate a theory of evolution. Organic evolution is the development of a plant or animal, in the course of time, by a sequence of changes resulting from the adjustment of the organism to its environment. All living organisms evolved from common ancestors in a gradual historical process of change and diversification. Later discoveries in the field of genetics have shown that Darwin's theory was essentially correct although the factors involved were oversimplified. This theory was more vulnerable to criticism in Darwin's time, because Darwin and his followers were never able to explain the causes of the variations which were essential to the theory.

Darwin recognized this weakness and throughout his life sought evidence in support of his theory. His work with variation lasted twenty-three years. He knew that the plant and animal breeders of England had long been obtaining more desirable types of animals by carefully breeding only those with the desired characteristics (artificial selection). He studied the domestic pigeon because a large number of species had developed through years of domestication. He found that all of these various breeds had descended from the common wild pigeon. He studies barnacles, and found that their relationships and descent were better expressed in the larva (young stage) than in the adult. This was embryological evidence for evolution. He studied the fossil evidence from the geological record. He used comparative anatomy to show that descent was implied in the present classification system. In all these studies, evolution provided the unity that had hitherto been lacking in man's concept of nature. Darwin also recognized that processes other than variation and natural selection were involved in evolution, and he never stopped searching for evidence of these processes.

Wallace's Influences on Darwin. Darwin was well aware of the contradiction between his theory of the origin of species through evolution and the prevailing belief that all living things were the result of a special creation. Perhaps, Darwin would never have published his views had it not been for Wallace. Alfred Wallace was another naturalist who, like Darwin, devoted his interest to animal life of the world. In 1858 Wallace, then in Malaya, sent Darwin a paper with instructions to have it published. It contained the same idea that Darwin had been working on for twenty years. On July 1, 1858, Darwin and Wallace jointly presented their conclusion to the Linnaeon Society of London. The following year, 1859, Darwin published the first edition of his book, *The Origin of Species by Means of Natural Selection*.

Heredity

Mendelian Genetics. The full development of the theory of natural selection was not reached until after Darwin's death. In spite of his extensive study of variation, he was never able to discover the process which *caused* variation or exactly how desirable characteristics were passed on from generation to generation. The key to variation was found by a man whose work was concerned with stability in the hereditary process.

Gregor Mendel was an Augustinian monk who lived in what is present day Czechoslovakia. Trained in both biology and mathematics Mendel obtained a background shared by few of his contemporaries. In seven years' work in the quiet monastery garden, Mendel made one of the greatest scientific discoveries of the nineteenth century--that heredity operated according to the mathematical laws of probability.

A well known example of the laws of probability is coin-tossing. If you were to flip a coin a large number of times, you would expect that it would turn up "heads" as often as "tails." Suppose you flipped it only ten times. You might get five "heads" and five "tails," but might get seven "heads" and three "tails." On occasion you might get ten "heads" and no "tails." But the more times you flipped it, the greater the probability that you would get the same number "heads" as "tails."

Mendel found success where others had failed because he studied large numbers of offspring, studied them over successive generations, concentrated on a few distinct traits, and analyzed his results mathematically. He worked with graden peas because the different varieties had distinct characteristics, and because they were normally self-fertilized. Self-fertilization meant that his plants would produce pure lines of identical offspring, generation after generation, unless he crossed them. (A cross is the mating of two individuals who differ in certain traits).

The conclusions from Mendel's experiments were:

1. There is a *pair* of genes[1] which control each trait.
2. During the reproductive process these genes separate and the *offspring receive one gene from each parent*.

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[1] The science of heredity is called genetics. The terms "gene" and "genetics" have come into use since Mendel's time.

It is hoped that the teacher will supplement this brief account with additional reading on the subject. The most concise accounts are found in high school biology textbooks. Two excellent ones are:

American Institute of Biological Sciences, Curriculum Study, *High School Biology*. Rand McNally, 1963.

________, *Biological Science: An Inquiry Into Life*. New York: Harcourt, Brace and World, 1963.

3. Some genes, when present, dominate the trait and the non-dominant (recessive) traits are visible only when the dominant gene is absent, i.e., when the plant contains two recessive genes.

4. Reproduction distributes genes among offspring according to mathematical laws of probability.

5. The genes for various traits are separated independently during reproduction. This allows a mathematical study of all the traits in a single cross. (Actually Mendel studied only seven traits).

Although Mendel's work was published in 1866, it is doubtful if anyone understood it; certainly no contemporary biologist grasped its universal significance. Almost half a century passed before the scientific community recognized that the riddle of heredity had been solved. Mendel, however, realized the significance of his work, and lectured and wrote to some of the most prominent scientists of his day. Nevertheless, Darwin's final edition of _The Origin of Species_, which was not published until 1872, gave no indication of knowledge of Mendel's work.

Modern Genetics. By the end of the nineteenth century, biologists had discovered that all living organisms were composed of cells and that all cells were produced by other living cells. The development of the microscope had made possible the study of cells and cell parts. It was observed that whenever a cell was in the process of splitting or dividing (reproducing), a number of rod-shaped bodies called chromosomes appeared in the cell nucleus. All cells contained these chromosomes, and the number of chromosomes was the same in all the cells of each species. There seemed to be a universal process by which the chromosomes duplicated themselves, and then divided, so that each new cell contained the characteristic number of chromosomes. There was one exception to this: the sex cells--sperm and egg--were produced by a similar, but different, process which reduced the number of chromosomes so that each one contained exactly one-half the chromosomes of the parents. This process was later found consistent with Mendel's conclusions, but there were many cases in which the number of observed traits was larger than the number of chromosomes. The investigators reasoned that a number of genes too small to be seen with any microscope were carried on each chromosome. In 1902 the rediscovery of Mendel's work and its combination with these investigations led to modern genetics.

Genetics explained the variation that had eluded Darwin, but at the same time showed that these variations were predictable by mathematics. Through the action of recessive genes, offspring could exhibit traits which were not obvious in either parent,[1] but in no case could the offspring receive genes that were not present in either parent. This process certainly would not give rise to the tremendous changes that had been so thoroughly documented by Darwin and his successors. Further investigation revealed a number of other hereditary processes: crossing over, mutation held the clue to evolution.

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[1] The term phenotype (visible type) is used in referring to all of the traits which may be observed in an individual while genotype (genetic type) refers to the actual group of genes carried by that individual.

Mutations. Mutation is simply change in the chemical structure of a gene. When a gene mutates, it becomes a different or "new" gene, and results in a new trait in the individual carrying the mutated gene. In a sense, mutations may be considered mistakes or errors in the duplication of chromosomes. Exposure to some chemicals and to radiation can speed up the rate of mutations, but cannot cause mutations. Many mutations are harmful and may even cause the death of the organism, but many are desirable. All the varieties of hornless (polled) cattle are the result of mutation. Gene mutation is the ultimate source for all new genetic material; in conjunction with natural selection, it furnished the basis for evolution.

A well-known example of the process of evolution is the case of the moths near Lancaster, England. These moths fly at night, and by day they rest on the bark of trees. When first observed, most of these moths were light-colored; occasionally a dark mutant appeared. At this time, the bark of the trees was also light-colored. Over a period of years, the smoke from the factories of Lancaster coated the bark of the trees dark. The birds could now more easily find and eat the light-colored moths. Selection favored the mutated gene for dark coloration. Today, most of the population consists of the dark-colored moths.

Many examples of change in characteristics over short periods can be found--all of them obvious characteristics, such as coloration. It must be emphasized that evolution is a long-term process and most of the changes that are recognized today as significant have required thousands of generations. The evolution of the horse from his small dog-like ancestor took approximately sixty million years. It is estimated that during this time 150,000 mutations of each gene involved with the changes could have occurred.

It must also be noted that the earlier emphasis given to survival of the fittest (kill or be killed) as a factor in natural selection was an over-simplification. Biologists now know that the actual killing of rival organisms plays only a small part in the overall picture of evolution. The strongest animals will have little effect on evolution unless they leave offspring.

The reptile egg is a good example; it arose from a series of changes that had nothing to do with struggle and killing. These changes merely resulted in an egg which would hatch on dry land. A water environment is more hazardous than a land environment during the incubation period of an egg. A greater proportion of the reptiles' eggs matured than was possible in the former water environment. Thus reptiles in the form of dinosaurs rapidly became the dominant creatures on earth, until they were superceeded by creatures still better adapted to a land environment.

Modern Synthetic Theory of Organic Evolution

Since the time of Darwin and Mendel, biologists have discovered additional factors which effect the evolutionary process: such as genetic drift, isolation and migration. These factors, together with natural selection and mutation, make up the modern synthetic theory of evolution. Each factor can be studied separately, but evolution is the result of the individual effects of each factor and their interaction.

Gene Pools. A clear understanding of two seemingly conflicting ideas is basic to any consideration of modern evolutionary theory. First, natural selection acts only on whole organisms, not individual traits. The well adapted individual may "carry along" a number of useless traits. Second, with the advances in genetics it has become apparent that studies of evolution must hinge on populations instead of **individuals**. A population is a particular group of closely related individuals living in a particular area. All individuals within a population differ both in visible traits and in the genes which they carry. If the individuals of a population freely interbreed among themselves and with no others, the interchange of genes is limited to the total of all the different genes contained by the various members of the population. It has been noted that many individuals live and die in the course of evolution. However, unless the entire population becomes extinct, the total group of genes continues generation after generation. This total group of genes is called a gene pool. As long as this gene pool is unchanged, there will be no change in the traits exhibited by the population. Although in the course of time, these traits may be expressed in many different individuals. Any change in this gene pool will result in the evolutionary change of the population. Both natural selection and mutation, as previously discussed, act on individuals but they also cause change in the gene pool. Other factors causing change in the gene pool are genetic drift and migration.

Genetic Drift. Genetic drift results from the accidental loss of certain genes from the gene pool. This usually occurs in a small isolated population. This is best explained by a simplified story. Suppose the gene pool of an isolated Eskimo village contains genes for both brown and blue eyes. In one generation, only one male hunter carries the gene for blue eyes. If he passes on this gene to his offspring, the gene for blue eyes will remain part of the gene pool of the group. But if this hunter is lost at sea while hunting whales, the gene will not be passed on to the next generation. There will no longer be any possibility of any future members of this group being born with blue eyes. It is easy to see that the smaller and more isolated a population is, the more possibility there is for genetic drift through accidental loss of certain genes.

In nature there are two types of isolation, geographic and biological. The squirrels on either side of the Grand Canyon are closely related, but they are visibly different. They have been isolated from each other so long that their gene pools have changed by either mutation and selection or by genetic drift. This is an example of geographic isolation that is apparent on opposite sides of mountains, across rivers, or where there is great distance between populations.

Biological isolation is usually related to breeding habits. Two similar groups of animals can occupy the same territory and maintain separate gene pools if one group breeds in March and the second group in July. More commonly, biological isolation results from the simple fact that most animals breed with their own group. This also occurs in man and is called social selection.

Migration. Another means of changing a gene pool is by migration. Migration is the movement of individuals into and out of a population. Depending on whether the individuals are coming in or leaving, migration can either add to or subtract genes from the gene pool. This results in evolutionary change in the population.

The migration of domestic animals is artificially controlled. No farmer with thousands of dollars invested in purebred cattle will allow them to run loose and interbreed with less desirable stock. He very carefully fences them in. Among other functions, the fence serves to isolate his cattle and thus maintain the gene pool.

Adaptation. Enumeration of the factors causing evolutional change leaves unanswered the question of direction in evolution. Why did the horse evolve from a dog-like animal into a larger animal?

Nearly all modern biologists recognize adaptation as the major directing factor in the process of evolution. Adaptation is any adjustment of an organism to its environment. Environment in this sense includes all the things and conditions surrounding the organism. Wild horses are adapted to living in an environment of grasslands. Their teeth are well suited for cropping grass, and their legs and feet are so developed that they can outrun most of their enemies. The hummingbird's long beak is an adaptation which enables him to obtain food from flowers with deep petals. All animals have thousands of adaptations.

It is important to recognize that most adaptations are useful in a specific environment only. The horse's speed would not be an advantage in a thick forest. Neither would gills be useful to an animal who does not live in water.

Adaptation is the result of the interaction of natural selection and the genetic variation of populations. Natural selection itself is the result of the interaction of the organism with its environment.

There is an entire branch of biology--ecology--devoted to the study of the interactions between the organism and its environment. Even small changes in the environment can change the relationship between the organism and the environment. When this happens, the organism must make new adaptations to enable it to survive in the changed environment. Since environments are always gradually changing, organisms must constantly make new adaptations. Adaptation is the directing force of evolution, but evolution is not directed toward any final goal. Adaptation directs evolution in the sense that the organism is gradually changing to adjust to the constantly changing environment.

Specialized and Generalized Animals. The terms "specialized" and "**generalized** ," when applied to animals, refer to the adaptations of the animal to its environment. A specialized animal is one that has developed traits and body parts enabling it to be very efficient in a specific environment. A grasshopper with wings, strong legs for jumping, and chewing mouth parts, is well adapted for life among grasses and low shrubs. Some other insects have become so specialized that they spend at least a portion of their lives on a particular plant.

A generalized animal is one who has developed few specialized parts and is able to live in various environments. Specialization and generalization are relative terms. All animals are specialized to some extent. A generalized animal is at a disadvantage when competing with a specialized animal if they both occupy the same environment. But generalized animals have the advantage of being able to move into new environments.

Environmental changes have caused extinction among many animals who had become very specialized. Competition with specialized animals has caused extinction among many generalized animals. Usually, the animals that have survived over long periods have been those who have become specialized enough to compete successfully in their environment and generalized enough either to adapt or to migrate when their environments change.

Man is a good example of such an animal. Man's hands are arms are generalized compared with the front limbs of other animals. The finger nails are not as efficient weapons as a cat's claws. The hand is not adapted to walk on as is a horse's hoof. Most monkeys have hands better adapted to climbing trees. Yet man can use his fist as a weapon, he can walk or crawl on his hands, he can climb trees or use his hands for many other purposes. Man's legs and feet, while less specialized than those of horses, are more specialized than the legs and feet of the great apes. Man cannot grasp objects with his feet as well as an ape, but he can stand erect and walk without the use of his arms--a feat difficult for apes.

The modern synthetic theory of evolution thus recognized four forces--natural selection, mutation, genetic drift, and migration. These forces are still operating today. However, man's culture is a significant factor in the adjustment of man to his environment.

Fossils and the Evolution of Life on Earth

The remainder of this chapter will present in capsulated from the history of evolution on earth. The more recent geological periods will be covered in greater detail, since this is the time during which man evolved. This will set the stage for a more detailed account in the next chapter for the fossil evidence for the evolution of man.[1]

The fossil record and the geologic time scale provide the record of the history of life on this earth and the only direct evidence of long-term evolution. This account is limited to an introduction which can serve as a basis for further investigation.

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[1] Most school science texts and all general biology texts present at least portions of the fossil record. An accurate and well-illustrated account of the evolution of major groups can be found in: Life: An Introduction to Biology, by Simpson, Pittendrigh and Tiffany. New York: Harcourt Brace, 1957.

Modern methods of dating rocks have placed the age of the earth at something over three billion years. It is known that there has been life on the earth for at least 500 million years. During this time countless billions of plants and **animals** have lived and died, but only a few have left a record of their existence in the form of fossils.

Fossils. Fossils are any remains or traces of plants or animals which lived in prior periods. They have been called accidents of preservation. Preservation may result from the animals falling into a tar pit, falling into a crack of a glacier, or merely crawling into a dry cave to die. Preservation by being covered by sediments is the most common way in which fossils are formed. Sediments which preserve fossils are commonly consolidated into sedimentary rocks by the tremendous pressures which occur when the sediment is deeply buried under more recent sediments. With the exception of those recovered by drilling and mining operations, all of the fossils found in rocks have been uncovered by the action of geologic forces.

The natural actions of decomposition, and the erosive effects of wind, water, and soil rarely allow the preservation of soft body parts. Fossil remains usually consist only of the hard parts such as the bones and teeth of vertebrates and shells of some invertebrates. Under certain special conditions, soft body parts may be preserved, but this is the exception rather than the rule.

Reconstruction from Fossil Evidence. At first glance this appears to be meager evidence upon which to base a history of life. However, fossils are not so scarce as they might seem. In many parts of the world, erosion has uncovered many large beds of fossils.

Paleontologists have been able to deduce much from bones and teeth because they have brought various fields of modern science to bear on their findings. Physics supplies the dating techniques, chemistry the newest methods for analyzing substances, botany the means of inferring climate, and comparative anatomy its knowledge of the similarities and differences between closely related organisms. Tooth structure, in particular, is consistent in indicating degrees of relationship among vertebrates.

In addition, this knowledge is cumulative. Some fossils have been found in undisturbed deposits in regions that have no datable remains. Others have been found with no trace of their associated phenomena. When only one specimen of any particular type is found, it is not possible to determine if the specimen was typical of his contemporaries. This is especially true if only part of a skeleton is found, as is most often the case. Precise dating of such isolated finds may also be a problem.

Fortunately, paleontologists have managed to find several sets of skeletal remains for most major fossils. As a result, what may be an inference on the basis of one fossil may be confirmed by the discovery of related fossils. For example, in 1925 Raymond Dart announced the discovery of a skull of a six year old child. This skull was ape-like but had several human characteristics. On the basis of this discovery, Dart set up a new genus, *Australopithecus africanus*, and stated that it represented an extinct race of apes intermediate between living apes and man. Many attacks were made on Dart; recognized scientists doubted his classification. Dart's case was proven only when numerous adult fossil remains of *Australopithecus* were found.

Limits of Reconstruction. Even when the fossil evidence is relatively complete, total reconstruction of the organism is impossible. The height, weight, body build, and posture can be estimated from the bones and knowledge of comparative anatomy. From the brain case, scientists can infer the brain size, which is a clue to the intellectual capacities of the organism. But reconstruction of the skin, hair and coloring must be based largely on speculation. There is no way of knowing the eye color, skin color, or amount of hair fossil man had. Artistic reconstruction of fossil men from Africa as black is based on the artist's imagination and is no more scientific than the green skin of Sinclair Oil Company's dinosaur.

Geologic Time and the Evolution of Life. A continuous history of life begins with the Cambrian period (refer to chart on the next page), because earlier fossils are extremely rare. The abundance of fossils in the Cambrian led paleontologists to assume that during the Pre-Cambrian, there may have been many soft-bodied creatures that did not fossilize. The Cambrian period has yielded fossils of sponges, one-celled animals, worms, and other sea dwellers. Every phylum except the one to which the vertebrates belong (phylum Chordata) is represented. There is no evidence of life on land at this time.

By the end of the Ordovician, the vertebrate group was represented in the form of primitive jawless fish, and true corals had begun to build reefs. The now extinct trilobites were abundant.

The most important event of the Silurian was the appearance of the first land plants. During the Devonian, fishes evolved into many distinct groups. Ancestors of the modern fishes appeared and began to replace some of the more primitive groups. In the late Devonian, one group of fishes, the crossopterygians, evolved into primitive amphibians, and animal life on land began.

The Carboniferous was a period of expansion of amphibians. One amphibian group, the cotylosaurs, gave rise to the reptiles. Insects appeared at this time and one, the cockroach, had essentially reached his present form. The Permian was a time of rapid increase in the number of reptiles. The therapsids were already evolving along the line which was to give rise to mammals.

The later Permian and the early Triassic were times of crisis in the history of life. Many groups died out and the remaining groups underwent rapid evolutionary change. The Jurassic saw the rise of the dinosaurs (reptiles) as the dominant land vertebrates. While some grew to tremendous size, one group of small creatures about the size of mice were evolving into the mamalian pattern. The first true birds with feathers also arose during this period.

GEOLOGIC TIME CHART

Eras	Periods	Epochs	Began Years Ago	Events
CENOZOIC (age of mammals)	Quaternary	Holocene	10,000	Rapid expansion of human culture.
		Pleistocene	1,000,000	Extinction of many large mammal. Homo sapiens.
		Pliocene	12,000,000	Australopithecines appears.
		Miocene	30,000,000	Great expansion of great apes (family Pongida
		Oligiocene	40,000,000	Evolution of modern mammal and first Hominoidea
		Eocene	60,000,000	Primate evolution begins--horse ancestor Eohippus appears.
		Paleocene	75,000,000	Rapid evolution and expansion of mammal.
MESOZOIC (age of reptiles)	Cretaceous		120,000,000	Extinction of Dinosaurs.
	Jurassic		155,000,000	First primitive mammals and birds appear. Dominance of dinosaurs.
	Trassic		190,000,000	Evolution of dinosaurs as progressive reptiles.
PALEOZOIC (age of ancient life)	Permian		215,000,000	Great expansion of the reptile groups.
	Carboniferous		300,000,000	Reptiles evolve from amphibians. Expansion of amphibian life. Rise of insects.
	Devonian		350,000,000	Amphibians evolve from fish. First land animals.
	Silurian		390,000,000	First known land plants.
	Ordovician		480,000,000	First fish-like vertebrat
	Cambrian		550,000,000	Invertebrate life in oceans and seas.
	re-Cambrian		4.5 billion beginning of earth	Little evidence of fossils.

The late Creteceous was a second period of great dying. The dinosaurs and most other reptile groups became extinct. This was probably due to widespread climatic change, but no one has been able to discover the specific cause of extinction. Only the lizards, snakes, and tortoises survived as land reptiles.

During the seventy-five million years from the beginning of the Paleocene Epoch, the mammals inherited the earth. The extinction of the land reptiles left large sections of the land environment empty. These gaps were filled by the mammals. By the end of the Paleocene, mammals had evolved into many diverse groups. They were gaining in size and specialization. Some had become meat-eaters, but only the monotremes (egg-layers) and marsupials (pouched mammals) had appeared.[1]

Placentals, the third group of mammals, evolved in the early Eocene and began to expand rapidly in numbers and in species. This expansion continued into the Oligiocene.

Sometime during the late Paleocene and Eocene, the early primates (Order Primates) began to evolve from the insectivores, the earliest placentals. In the Oligiocene and the Miocene, some of these early primates gave rise to the ancestral forms of the early apes (Hominoidea). During the Pliocene or earlier, this Hominoidea line must have split, for by the Pleistocene there is clear fossil evidence for two separate lines--the family *Pongidae* which gave rise to the modern great apes and the family *Hominidae* which gave rise to modern man.

Fossil Man. All of the datable finds concerning fossil man come from the last geological epoch, the Quaternary, which may be divided into the Pleistocene and the Holocene. This fossil evidence for human evolution will be presented in the next chapter. But first, in order to understand the chronology of man's evolution and the environmental factors effecting early man, it is necessary to review briefly the climate and animal life present in the Pleistocene and Holocene Epochs. (See chart on page 18). To set the stage for human evolution, it is necessary to review in more detail the chronology, climate, and animal life present in the Pleistocene and Holocene Epochs.

Methods of Determining Pleistocene Chronology. Chronology for the Pleistocene may be based on one or more of the following methods: climatological data, paleontological data, data based on the measurement of radioactivity, and data based on cultural change. As the latter two are discussed in the chapters entitled "Archeological Methods," and "Old World Prehistory," respectively, chronology based on climatological and paleontological evidences will be examined. Not one of the methods agrees with any one of the others in a one-to-one correlation, and none is universally applicable. Because of this discrepancy, anthropologists often find it difficult to compare the fossil men of different regions by date.

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[1] Mammals are divided into three categories on the basis of reproduction. The monotremes are considered the most primitive and the placentals, which give birth to well developed living young, the highest. Placentals are the dominant creatures of the earth today.

Pleistocene Climate. Most scientists agree that the Pleistocene Epoch began a million or more years ago and lasted until the Holocene Epoch (modern times) began about 10,000 years ago. The Pleistocene is sometimes called the Ice Age. In this period there were at least four times when large areas of the earth's surface were covered with glaciers like those now covering Greenland.

During these periods of glaciation, sheets of ice reached into the northern United States and down into France in Europe. The topography of many areas was altered by the weight of the ice on the land surfaces. So much water was trapped in these ice sheets that the level of the seas was lowered, making major changes in the world's coastlines. For example, England was connected to Europe by a large low plain and a land bridge joined Siberia and Alaska.

The climate in Europe, northern America and northern Asia was very cold during glacial periods, and warm climates were found only much closer to the equator. But all of the Pleistocene was not a time of glacial advance. First, there was a long period of slight cooling and heavy rainfall, called the Villafranchian, before the first glaciation. Then, between each of the four periods of glaciation, there were three long interglacial periods when the ice retreated and the climate in Europe became as warm as it is today, if not warmer. (See chart on page 18).

Pleistocene Climate and the Dating of Fossil Men. Because of the difficulty in dating these distant times precisely, archeologists usually speak in terms of geological events rather than in terms of years. The four glaciations and the three interglacial periods provide a framework for establishing the relative age of fossil finds when the exact age in number of years is not known. (See Archeological Methods pages 14-17 for a discussion of relative and absolute dating). There is a second reason for referring to events in man's prehistory in these terms: remains of early man's activities are often discovered in the waste material left by a glacial advance. Since these materials were moved by the glacier, the archeologist knows only that the materials are as old or older than the glacial advance that moved them from the sites where early man left them.

Paleontological Data. A second method for dating the Pleistocene is by the use of paleontological data, which involves regional comparisons and contrasts of fossil remains of numerous extinct animal species. In general, the use of dating based on geological events is preferred to paleontological materials. But paleontological data is also useful because it reveals the animal and plant life that made up part of the environment of fossil man.

In general, the Pleistocene witnessed the evolution of the large bodied mammals, including several forms of the elephant, rhinoceros and hippotamus, the sabre-toothed cat, cave bear, and giant deer. All of these were larger than their living forms. The range of Pleistocene plants and animals varied with the variations in the Pleistocene climate. During periods of glacial advance, plants and animals accustomed to warm weather were found only in the extreme south; most of Europe was inhabited by plants and animals accustomed to arctic weather. Plant and animal life shifted northward during the long warm interglacial periods. During the interglacials most of Europe was inhabited by large animals similar to those found in Africa today, and arctic forms of life were found only in the extreme north. At the end of the last glaciation and the beginning of the Holocene Epoch (modern times) many forms of life, including the mammoth and wooly rhinoceros, became extinct, leaving plant and animal life essentially as it is today. (See the chart on the next page).

The following chapter will trace the fossil evidence for the evolution of man.

EUROPEAN CLIMATE AND ANIMAL LIFE DURING THE PLEISTOCENE AND HOLOCENE

Years Ago	Paleontological Chronology	Geological Chronology	Typical Animals
10,000	HOLOCENE	HOLOCENE EPOCH (Modern Times)	Modern animals in present ranges
	UPPER PLEISTOCENE	4th Glaciation (Wurm)	Wooly mammoth and rhinoceros, bison, great ox and musk ox, horse, cave bear, arctic fox and other arctic animals
		3rd Interglacial	Hippopotamus, straight tusked elephant, brown bear, beaver lion, leopard, red deer, giant elk
190,000	MIDDLE PLEISTOCENE	3rd Glaciation (Riss)	Wooly mammoth and rhinoceros, bison, reindeer, musk ox, other arctic animals
		2nd Interglacial	Macaque monkey, rhinoceros, deer, 1st straight tusked elephant, great ox, bison, modern species of horse
480,000		2nd Glaciation (Mindel)	Arctic animals
	LOWER PLEISTOCENE	1st Interglacial	Macaque monkey, sabre-toothed cat, elephant, 2 types of rhinoceros, red deer, hippopotamus
		1st Glaciation (Gunz)	Arctic animals
1 million or more		Preglacial (Villafranchian)	Macaque monkey, great sabre-toothed cat, mastodon 1st of the true elephants 1st of the true horses

NOTE: This chart is intended as a rough approximation only. Further advance in scientific dating could lead to modification of the dates given. In addition, local conditions caused considerable differences in climate and plant and animal life. Vertical dimension on this chart is not to scale.

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FOSSIL MAN

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THE DEVELOPMENT OF MAN AND HIS CULTURE

OLD WORLD PREHISTORY

Teacher Background Material

Grade Five

FOSSIL MAN

Introduction

The preceding chapter explained the mechanism for evolutionary change, and pointed out the general trends involved in the development of life on earth. For the student of human evolution, an overview of the fossil remains of near-human forms is basic to an understanding of the more significant *genera* and *species* known to be directly related in the evolutionary development of modern *Homo sapiens*. A survey of the early primate pattern will follow.

The earliest known primates, called Prosimians, lived during the Paleocene and Eocene epochs (see chart), and their remains have been found in both the Old World and the New World. Although we lack information directly relating any specific prosimii as ancestral to later primates, the evidence that we have indicates a radiation of the prosimii during the Eocene. Some of these forms gave rise to the later primates.

Years Ago	Geological Period	Fossil Form
12,000,000	Pliocene	Oreopithecus
25,000,000	Miocene	Dryopithecus
34,000,000	Oligocene	Early Simians
55,000,000	Eocene	Early Prosimians
71,000,000	Paleocene	

Proconsul. There are more fossil remains dating from the Miocene than from the previous two epochs. Africa was a center of *primate evolution*, and from here several species of the genus Proconsul have been found. These appear to be ancestral to the gorilla and the chimpanzee or, possibly, may be the common ancestor of the modern apes, and of man.

Dryopithecus. At the beginning of the Pliocene, a different genus of apes had become common in Europe, Asia, and Africa. Known collectively as Dryopithecines, these early apes possessed features found only among the anthropoids. Some members of this genus show traits which seem ancestral to chimpanzees and gorillas; others show traits which are ancestral to man. However, until additional evidence is uncovered, anthropologists merely speculate about the significance of the Dryopithecines in the line of human evolution.

Oreopithecus. Recent examination of the remains of the genus Oreopithecus indicates affinites to the human evolutionary line, although earlier scientists considered this genus ancestral to the Old World Monkeys. However, actual inclusion of Oreopithecus in the hominid line is currently the subject of debate. Some anthropologists consider Oreopithecus as ancestral to the hominid line on the basis of the hominid character of the teeth and jaw. Other anthropologists, noting tooth patterns and other features shared by Proconsul, Dryopithecus, and the modern anthropoids, and not found with Oreopithecus, contend that the latter is merely an extinct variety of monkey.

Bridge to the Pleistocene. A summary of what the anthropologists have inferred from their examination of early primate forms will help the reader understand what is known of the earliest hominids.

The earliest known primates appeared in the Paleocene and Eocene. During the Oligocene, there was a separation of monkeys and hominids, possibly from a common ancestor. In the Miocene and Pliocene, Proconsul and Dryopithecus appeared, the former (or a similar form) possibly being ancestral to the latter. The Dryopithecines, or forms similar to this genus, gave rise to ancestral forms leading to the anthropoids. Present evidence indicates that Oreopithecus was a divergent form.

At the present time there are no known fossil forms which directly associate any Pliocene genera to the later Hominidae. The earliest known hominid forms do not appear until the late Pliocene or early Pleistocene. However, the fact that these earliest known hominids were widely scattered and structurally divergent indicates that hominid forms were in existence prior to the Pleistocene.

Before proceeding to a discussion of those genera and species that are most important in an understanding of the evolutionary development of modern man, let us examine our system of classification. In the chapter on evolution we noted, among other things, that a good taxonomy is based on similarities as well as differences. We must remember, that even with man, no system of classification is rigid and unchangeable. New discoveries and techniques show us that some fossil men, once thought to be different species are, in fact, members of the same species.

In the classification that follows, only the major fossil men have been included. Disputed finds, questionable cases, and some subclassifications of interest only to the specialist have been excluded. The system that we use is not intended as an evolutionary scheme. It does not mean that the first listed fossil man necessarily gave rise to the second, and so on. However, the astute student will note that the taxonomy does list the fossil finds, beginning with Australopithecus, in order of the development of features which approach those of modern man.

Australopithecines

Australopithecus africanus and robustus. The relative abundance of Australopithecine remains has made it clear that several types are represented. Australopithecus africanus was the earliest form of this species to be found; his remains were discovered in limestone quarries in southern Africa. The discovery, made by Raymond Dart in 1924, was of a juvenile with a cranial capacity of 600 cc, similar to that of some living apes. Analyses of later finds show a cranial capacity from 450-750 cc., and indicate that he stood about 5 feet tall and weighed about 50 to 60 pounds. Some anthropologists believe that the pebble tools found with Australopithecus' remains are proof of his present classification as hominid. Remains of Australopithecus robustus (often called Paranthropus) have been discovered in South Africa at Kromdraii and Swartkranz. At the latter area, the fragments of a more human form, called Telanthropus, were also discovered. Some anthropologists argue that the evidence from the site at Swartkraz indicates that the Australopithecines were hunted by Telanthropus.

Years Ago	Geological Period	Climatological Period	Fossil Form
1,000,000	Lower Pleistocene	Gunz/First Interglacial	Australopithecus -africanus -robustus
1,500,000			Zinjanthropus Homo habilis

Anatomical Considerations. By careful examination of muscle origins and insertions on the bones, by studying the pelvis, **femur**, and the position of the foramen magnum, anthropologists have concluded that the Australopithecines stood erect. They apparently walked on their legs and not on all fours as did other primates. The legs seem more modern than the skulls, but some authorities believe that their gait was more of a shuffling run than the long stride characteristic of modern man. Their teeth were clearly human in form, but the jaws were large and heavy, no doubt to support the muscles needed for chewing raw, coarse foods. The skull was long and rather high, with a heavy ridge over the brows; the position of the foramen magnum and other skull and neck features indicate that the head was thrust forward.

Diet. Although the Australopithecines were primarily vegetarian, they probably supplemented their diet with the flesh of small animals. The climate of that time was warm and mild, so survival against the weather should not have been difficult.

Zinjanthropus boisei. It was generally accepted that man did not arrive until the Pleistocene period, the beginning of which is conventionally set at about one million years ago. L. S. B. Leakey's remarkable discovery of Zinjanthropus boisei at Olduvai Gorge, Africa, in 1959, has altered the concept of the antiquity of man. Zinjanthropus has been dated by the potassium-argon technique at about 1,500,000 years (See Archeological Methods). This indicates that the Australopithecines flourished as far back as the last stages of the Pliocene. Although Leakey concluded that Zinjanthropus differed significantly enough from africanus and robustus to require a new name, J. T. Robinson and others have classified Zinjanthropus with the robustus sub-species. Even though his face and skull are coarser than most other Australopithecines, he was clearly a man as they were.

Cultural Implications. When first discovered, Zinjanthropus was considered the oldest known toolmaker who had a definable culture. Evidence for this assumption was strong: crude tools and broken bones of small animals were found in close association with his remains. Although current evidence does not rule out the possibility that he *did* make tools, it suggests that he was the *hunted* and not the hunter. (See Old World Prehistory).

Homo habilis. Remains of a second form, now classified as *Homo habilis* and earlier than Zinjanthropus, were discovered in the same locality as Zinjanthropus. Homo habilis had a cranial capacity of about 682 cc., a hand with an opposable thumb, and stood about 4 feet tall. His jaw structure indicates that he could have had speech. Crude stone tools found with his remains (See Old World Prehistory) is further evidence for classifying him as man.

Significance of the Australopithecines. The Australopithecines are the oldest known hominids; they represent the hominid bridge from the Pliocene to the Pleistocene. Analysis of Australopithecines remains indicated that the earlier Australopithecines (Homo habilis) had physical features more nearly approaching those of later Hominidae than did the later Australopithecines (Zinjanthropus) and robustus. From this, some anthropologists have inferred that the genus Australopithecus had many different forms, rather than one evolving in a line. Other anthropologists maintain that there were two main forms of Australopithecines, one primarily vegetarian, the other with flesh in his diet. Although both vegetarians and meat eaters were representatives of the earliest known hominid form, some contend that the meat eaters persisted and led to later forms, while the vegetarians died out. The meat eaters used tools. Eventually they won out over the non-toolmaking vegetarians.

Homo Erectus

Homo erectus erectus. In 1891 a Dutch military surgeon, Eugene DuBois, discovered remains of the famous *Java Man* while excavating at Trinil in search of evidence of man's origins. Originally classified as Pithecanthropus erectus by its discoverer, DuBois, we now know that this fossil remain was truly human.

The name Java Man is used to refer to fossil forms of the Homo erectus erectus species found in Java. Similar remains belonging to this same group include the Chellean-3 skull from Olduvai, Africa, fragments from Ternifine, Algeria, and possible Heidelberg from Germany.

Years Ago	Geological Period	Climatological Period	Fossil Form
190,000 to 480,000	Middle Pleistocene	2nd Glacial-- 3rd Glacial	Homo erectus- -erectus -pekinensis -chellean-3

Anatomical Considerations. Java Man had a short face with enormous brow ridges. His forehead was so low, narrow, and slanting that it was almost nonexistent; his jaw protruded near the mouth and he was almost chinless. The all-important brain case shows brain size to be about 900 cc, indicating a higher potential intelligence than the *Australopithecines*. In terms of evolutionary development, this trend toward higher brain size is an example of specialization. The fact that the left frontal lobe of the brain was larger than the right lobe indicates that he may have been right-handed. Java Man stood erect, walked upright, and stood about 5 feet 8 inches tall. He also had large powerful neck muscles. The position of the foramen magnum on his skull, as compared to that of the *Australopithecines*, indicates his head was better balanced on the neck.

Homo erectus pekinensis. Since 1929 the remains of nearly 40 individuals have been excavated from the Middle Pleistocene limestone cave deposits about 40 miles from Peking, in the village of Choukoutien, China. First named *Sinanthropus* and later *Pithecanthropus pekinensis*, this sub-species is now called *Homo erectus pekinensis*.

Anatomical Considerations. Peking Man is essentially like Java Man but has certain more advanced characteristics. His larger skull case indicates a cranial capacity as great as 1300 cc. Although his teeth are large, they are smaller than those of Java Man. The forehead is also more modern. On the basis of measurements of the femur, it is estimated that the average adult stood about 5 feet 1 inch in height, somewhat shorter than Java Man.

Other Homo erectus Finds. Other representatives of the Homo erectus species have been discovered. The remains of a child at Modjokerto, Java are possibly of an early Pleistocene Homo erectus. The Chellean-3 skull at Olduvai, Africa indicates the presence of Homo erectus in areas other than Asia (Chellean-3 is thought to have lived at the same time as Peking Man). The right parietal bone and three mandibles found in 1954-55 at Ternifine, Algeria could be Homo erectus erectus, but some anthropologists doubt this because of its association with Acheulean tools. (For Tool Types, see Old World Prehistory.)

Summary of Homo erectus. The 500,000 year morphological gap between the Australopithecines and the first sapiens is spanned by the numerous fossil finds of Homo erectus. Considered collectively, Homo erectus represents a stage higher in the evolutionary development of man than does Australopitheucs. The average brain size was larger than that of Australopithecus, but approaches that of modern man only in gross size. The brain was also more specialized. An enlarged frontal lobe found in some of the finds indicates a trend toward right handedness. The average skull was better balanced on the neck, thereby facilitating upright walking. Tools and burnt bones found near, and in some cases with, his remains indicate that he made and used tools. He was also the first to use fire. By the beginning of the Middle Pleistocene, Homo erectus forms apparently had adapted to a wide range of climates and geographic locations. They occupied large parts of East Africa, Java, and even subglacial northern China.

Homo Sapiens Neanderthalensis

Since the first discovery in Germany in 1856, the caves of the last glaciation have revealed a variety of fossil remains of the most widely known of all the fossil men, the Neanderthal. More than a hundred fossil finds have been made in western and southern Europe, central and southwestern Asia, and west Africa. Most anthropologists agree that Neanderthal is a subspecies, *Homo sapiens neanderthalensis*.

Years Ago	Time Period	Climatological Period	Fossil Finds
190,000- 40,000	Upper Pleistocene	3rd Interglacial - Early Wurm	Neanderthal

Classic Neanderthal. The classic Neanderthal has been reconstructed from examination of many specimens. Our popular--though erroneous--conception of the cave man is a hairy brute with stooped shoulders, lugging a club and dragging his mate by the hair. The stereotype of the stooped over Neanderthal comes from the "Old Man" of La Chappell-Aux-Saints, France. Recent examination of his skeleton indicates that his bent posture was due to a disease very much like arthritis, and was not a genetic trait.

Anatomical Considerations. Fossil finds come from more than 40 sites, so there is ample evidence from which to generalize about Neanderthal Man. His bones were thick and the skull was large, long, low and narrow, and relatively flat on top. The heavy brow ridge curved up over the eye; the nose was broad and flat, and he had only the beginnings of a chin. His teeth were arranged in a manner similar to those of modern man, although the roots tended to be fused. The neck vertebrae are of particular interest, for they are shaped in a way that could provide attachment for the large muscles needed to move the massive skull. Undoubtedly he had great difficulty in moving his head from side to side. Examination of his leg bones indicates his normal resting position was a squat, and it appears from his ankle bones that the outer edges of his feet supported the bulk of his weight. The typical Neanderthal body was a few inches over five feet in height and had relatively short arms and legs. His brain size, ranging from 1300 cc to 1800 cc, was actually larger than that of modern Europeans; however, the forebrain was smaller and less well-developed than that of contemporary man. The best indication of his intelligence comes from evidence of a full and rich culture, which will be outlined in the next chapter.

Mount Carmel Man. In Palestine, skeletons of Mount Carmel Man were found in two famous caves, Skhul and Tabun, as well as material identified with the beginning of the last glaciation (Wurm). The Tabun cave material included a male mandible, a female skull and skeleton, a femur shaft and a molar tooth. Examination of these fossils indicates that they fit into the Neanderthal series. Recent Carbon-14 dating (see Archeological Methods) places Tabun as the more recent of the two caves.

The Skhul site is of major importance because the fragments of the ten men and women found were fairly modern in type, and show a progression from Neanderthal to modern man. At best, they represent a mixture of Neanderthal and modern type populations.

Homo sapiens spaelus

Some of the fossil men once classified with the Classic Neanderthal type seem too modern to have resulted from normal genetic differences in the Neanderthal population. For a number of years, some of these fossils were called "Progressive" Neanderthals to distinguish them from the Classic Type. Recent re-examination of all major fossil specimens shows that these before--and are all older than the Classic type. (For clarification of Mousterian, see Old World Prehistory.) We now realize that at least four of these fossil men are sufficiently different to warrant classification in a new sub-species: Homo sapiens spaelus.

Years Ago	Geological Period	Climatological Period	**Fossil Form**
440,000- 40,000	Middle Pleistocene	2nd Interglacial- Early Wurm Glaciation	Homo sapiens -spaelus

Steinheim. The fragments of the Steinheim skull were found in 1933 in Germany in association with artifacts dating from the Second Interglacial. This young female's skull is relatively low; the brow ridge is heavy, but not to the extent of Neanderthal's. The left side of the face appears to have been crushed by a sharp blow. The brain size is small--about 1000 cc--which makes it closer in size to that of modern man than to that of Neanderthal. A fairly high forehead and the contours of the skull are further indications of its nearness to modern or Homo sapiens sapiens skulls.

Swanscombe. In 1935-6 and again in 1955, the occipital and parietal bones of a skull were found in Pleistoncene gravels of the Thames River at Swanscombe, England. These well-preserved bones were those of a 20-year-old woman, and were quite modern in type, although thicker. Early tools and bones of animals typical of the Second Interglacial were found in association with the Swanscombe fragments.

Fontechavade. In 1947, fragments of two human skulls were found in a cave site at Fontechavade, France, together with stone implements. (See Old World Prehistory for culture type.) The deposits were covered by a strata of a later date, thereby placing them prior to Neanderthal times. Like Steinheim and Swanscombe, the skull was fairly modern, although the bones were thicker than those of modern man. Significantly, Fontechavade Man lacked the prominent brow ridges and had a more modern forehead. One inference that may be drawn from these changes in facial structure is that man was beginning to depend more on his brain. Powerful massive jaws were becoming less important for survival.

In general, Homo sapiens spaelus appear to have existed before as well as contemporaneously with Neanderthal. But, anthropologists disagree about his position in the evolution of modern man. Neanderthal Man of the Classic type was formerly thought to be a highly specialized variety of man with physical features best suited for survival in the harsh glacial climate. However, the character of the Shanidar remains in Asia, those of Jebel Irhoud in Morocco, and the finds at Mapa, China, show essentially Classic Neanderthal characteristics. Neanderthal Man disappeared in the Upper Paleolithic with the appearance of Homo sapiens sapiens types. Some anthropologists hold that this was due in part to hybridization with the new immigrants. Others maintain that he became extinct. The former seems more plausible, for some fossil finds in Czechoslovakia show features indicating a mixture of Neanderthal with Cro-Magnon. Evidence of cultural contacts between the two have been noted in studies of the tool traditions (see Old World Prehistory).

Summary: *Neanderthal and spaelus*. Until recently, all European fossil men from the same general time period were classified as Neanderthals, although many differed widely from the Classic type. Re-evaluation of all these finds has shed new light on the significance of Neanderthal in the human evolutionary line. At present, these European specimens dating from Middle Pleistocene to early Upper Pleistocene are considered early forms of the species *sapiens*, and have been given the taxonomical name *Homo sapiens spaelus*. Although these forms resemble Neanderthal in certain characteristics, they have more traits that approximate those of later sapiens. Evidence indicates that those of the species spaelus who were trapped in Europe during the latter part of the Third Interglacial and the beginning of the Wurm rapidly evolved toward the Neanderthal form. These Neanderthal forms continued as a specialized adaptation to the extremely cold environment, but the general evolutionary trend was in the direction of modern man.

Other Homo Sapiens

Solo Man and Rhodesian Man. Two other finds are significant although they are neither Neanderthal nor spaelus. *Solo Man*, found in Java and dating from the Wurm Glaciation, had a skull intermediate in form between Homo erectus and Homo sapiens neanderthalensis. By 1965, eleven specimens had been found, and the condition of the bones indicates they may have been eaten at a cannibalistic feast. *Rhodesian Man*, found at Broken Hill, Rhodesia, in 1921, and the skull cap of *Saldanha Man*, found in South Africa, seem to be similar to Solo Man. Although some anthropologists class Rhodesian Man and Saldanha Man as Homo sapiens rhodesiensis, the taxonomy is still being debated. They are mentioned because the reader may encounter their names in his references.

Homo Sapiens Sapiens

Modern men are all members of the subspecies Homo sapiens sapiens. Other types of this subspecies lived during the prehistoric era. Not all Upper Pleistocene forms resembled modern man; there was a wide diversity of types.

Cro-Magnon Man. First discovered and best known was the Cro-Magnon Man from the Dordogne region in France. His remains, which now total over a dozen, were discovered in association with deposits of the Aurignacian epoch (see Old World Prehistory).

The skull is similar to modern man, and while the brow ridges were moderately developed, they are well within the range of skull features found today. Judging by the bones, he was fairly tall, his skull was low, and his facial features clearly modern European. His skull capacity measured as high as 1660 cc. Other men of this period were quite similar to Cro-Magnon, and some anthropologists have assigned the term Cro-Magnon itself to be used as a general category for these, our immediate predecessors. However, we shall examine the more important finds separately.

Grimaldi Man. Grimaldi Man, known from the remains of a woman and a young boy, was found on the Riviera coast. These forms were contemporary with Cro-Magnon, and artifacts associated with the finds indicate the date to be early Aurignacian (see Old World Prehistory). The specimens are similar to Cro-Magnon, but with characteristics which have led to classification as different as Negroid and Mediterranean Caucasoid.

Predmost, *Bruun*, *Combe-Capelle*. The Predmost and Bruun types found in association with Solutrean culture in Czechoslovakia, and the Combe-Capelle type found in France, are of interest because they appear to be a mixture of Neanderthal and Cro-Magnon. This is significant, for it supports the hypothesis that Neanderthal Man was absorbed rather than replaced by his successors.

Chancelade Man. The remains of Chancelade Man, discovered in France and dated from Magdellenian age, resemble the modern Mongoloid subspecies in certain respects. However, other features of his remains offer no support for this theory. It is thus preferable to describe Chancelade Man as essentially Cro-Magnon with a few Mongoloid-like traits.

Years Ago	Geological Period	Climatological Period	Fossil Forms
40,000	Upper Pleistocene	Wurm	Homo sapiens -sapiens

The process of change in the human form did not end with the arrival of Homo sapiens sapiens. The processes of evolution are at work today. As is seen in the description of Cro-Magnon Man, some individuals showed variations that were suggestive of modern races. The interpretations of racial history from skeletal materials must be approached with great caution. Most of the characteristics that are commonly used to identify the various races are non-skeletal and are not reflected in skeletal materials.

What we do know is that the various forces of evolution resulted in differential change in local geographic areas of the world. The oldest identifiable resemblances are in Europe where Paleolithic forms show resemblances to modern Europeans, particularly the Mediterraneans. Negroids are identified next in the East African Mesolithic and clearly recognizable Mongoloids appeared a little later. Even today, we can observe the emergence of new races. The Ladino or Mestizo of Latin America is the result of the mixture of the invading groups, mostly Mediterranean Caucasoid, with the local Indians. The bulk of the immigrants to North America have been Caucasoids drawn from all of the local races of Europe. Other groups have likewise contributed to a small but significant degree. In the future other changes will take place throughout the world.

Summary: Homo sapiens sapiens. By the end of the Wurm glaciation the Neanderthal population had vanished and a new species--sapiens sapiens--had become dominant. Although contemporary man is included in the same genus, sapiens sapiens included a diversity of types, many of which had some Neanderthal traits. From this evidence certain anthropologists have inferred that some early Homo sapiens sapiens existed contemporaneously with Neanderthal and interbred with them. Others maintain that Neanderthal was wholly displaced by the sapiens sapiens and represented only one of the many types in the evolutionary development of man. The sapiens sapiens of the late Upper Pleistocene period developed the stone-tool industries characteristic of the Upper Paleolithic. They lived in small bands as hunters and gatherers; their technology began to improve at a more rapid rate; and their survival became dependent upon adaptation to culture.

The next chapter will deal with the development of man's culture. It will show the progressive development of his culture from the pebble tools of the Australopithecinae to the rise of urban civilizations in the Middle East.

TAXONOMY OF MAN

Family: Hominidae
Genus: Australopithecus

Species: Homo habilis
Zinjanthropus boisei
Australopithecus africanus
Australopithecus robustus (Paranthropus)
Telanthropus

Genus: Homo
Species: Homo erectus
Subspecies: Homo erectus erectus (Pithecanthropus--Javan Man)
Homo erectus pekinensis (Sinanthropus--Peking Man)
Homo erectus modjokertensis
Chellean-3 (uncertain classification)

Species: Homo sapiens
-Rhodesian
-Saldanha
-Solo
Subspecies: Homo sapiens spalus
-Steinheim
-Swanscombe
-Fontechevade
-Mt. Carmel
-Skhul
Homo sapiens neanderthalensis (Neanderthal Man)
-La Chapelle aux Saints
-Mt. Carmel
-Tabun
Homo sapiens sapiens
-Cro-Magnon
-Grimaldi
-Predmost
-Bruun
-Chancelade
-Modern Man

CHECK LIST OF FOSSIL FINDS

	LOCATION	DATE OF DEPOSIT	FOSSIL MATERIAL	CRANIAL CAPACITY
Australopithecus				
-Homo habilis	Olduvai Gorge	Upper Pliocene	Parts of skull, hand, foot, scapula, upper molar tooth.	682 cc.
-africanus	South Africa	Lower Pleistocene	Infant skull; 24 milk teeth; 4 permanent teeth.	600 cc.
-robustus				
-Zinjanthropus	Olduvai Gorge	Upper Pliocene	Near-adult skull.	600 cc.
Homo erectus				
-erectus	Java	Middle Pleistocene	Skullcaps, limbs, and teeth	900 cc.
-pekinensis	China	Middle Pleistocene	Parts of skulls, jaws, and teeth.	1300 cc.
-Chellean-3	Africa	Middle Pleistocene	One skull.	
-Ternifine	Algeria	Middle Pleistocene	Part of skull; jaws, teeth.	
-Modjokerto	Java	Lower Pleistocene	Skullcap of baby.	
-Telanthropus	South Africa	Lower Pleistocene	Jaw; two molars.	
Homo sapiens				
-Solo Man	Java	Upper Pleistocene	Skull parts; tibias.	1300 cc.
-Rhodesian Man	Rhodesia	Upper Pleistocene	Skull.	1200-1300 cc.
-Saldanha Man	Africa	Upper Pleistocene	Skull parts.	1200-1300 cc.
-neanderthalensis				
-Classic	France	Upper Pleistocene	Complete skeletal remains	1300-1800 cc.
-Mt. Carmel	Palestine	Upper Pleistocene	Skulls, skeletons, teeth.	
-Shanidar	Iraq	Upper Pleistocene	Skulls, skeletal remains	
-Jebel Irhoud	Morocco	Upper Pleistocene	Skull cap	

	LOCATION	DATE OF DEPOSIT	FOSSIL MATERIAL	CRANIAL CAPACITY
Homo sapiens				
-spaelus				
-Steinheim	Germany	Middle Pleistocene	Female skull	1000 cc.
-Swanscombe	England	Middle Pleistocene	Female skull parts	1300 cc.
-Fontechavade	France	Middle Pleistocene	Skull parts	
-sapiens sapiens				
-Cro-Magnon	France	Upper Pleistocene	Five skeletons	1660 cc.
-Grimaldi	Monaco	Upper Pleistocene	Two skeletons	
-Predmost	Czechoslovakia	Upper Pleistocene	Forty skeletons	
-Bruun	Czechoslovakia	Upper Pleistocene	Several skeletons	
-Combe Capelle	France	Upper Pleistocene	One skeleton	
-Chancelade Man	France	Upper Pleistocene	One skeleton	

FOSSIL FINDS IN EUROPE, ASIA, AND AFRICA

YEARS AGO	TIME PERIODS	CLIMATOLOGICAL PERIODS	EUROPE	MIDDLE EAST	JAVA	CHINA	AFRICA
10,000		Late Wurm	Cro-Magnon Other H.s.s. Predmost Bruun Chancelade Grimaldi Combe-Capelle	Mt. Carmel -Tabun -Skhul	Wadjak Solo	Choukoutein Mapa	Rhodesian Man Saldanha Man
40,000	Upper Pleistocene	Early Wurm Third Interglacial	Neanderthal -La Chapelle Aux Saints	Neanderthal -Shanidar			
190,000		Riss Second Interglacial	Fontechevade Steinheim Swanscombe Heidelberg		Java Man	Peking Man	Chellean-3 Ternifine
440,000	Middle Pleistocene	Mindel					
480,000		First Interglacial Gunz					Tepanthropus Tchad
750,000	Lower Pleistocene	Villifranchian					Australopithecu -africanus -robustus
1,000,000							-zinjanthropus -habilis

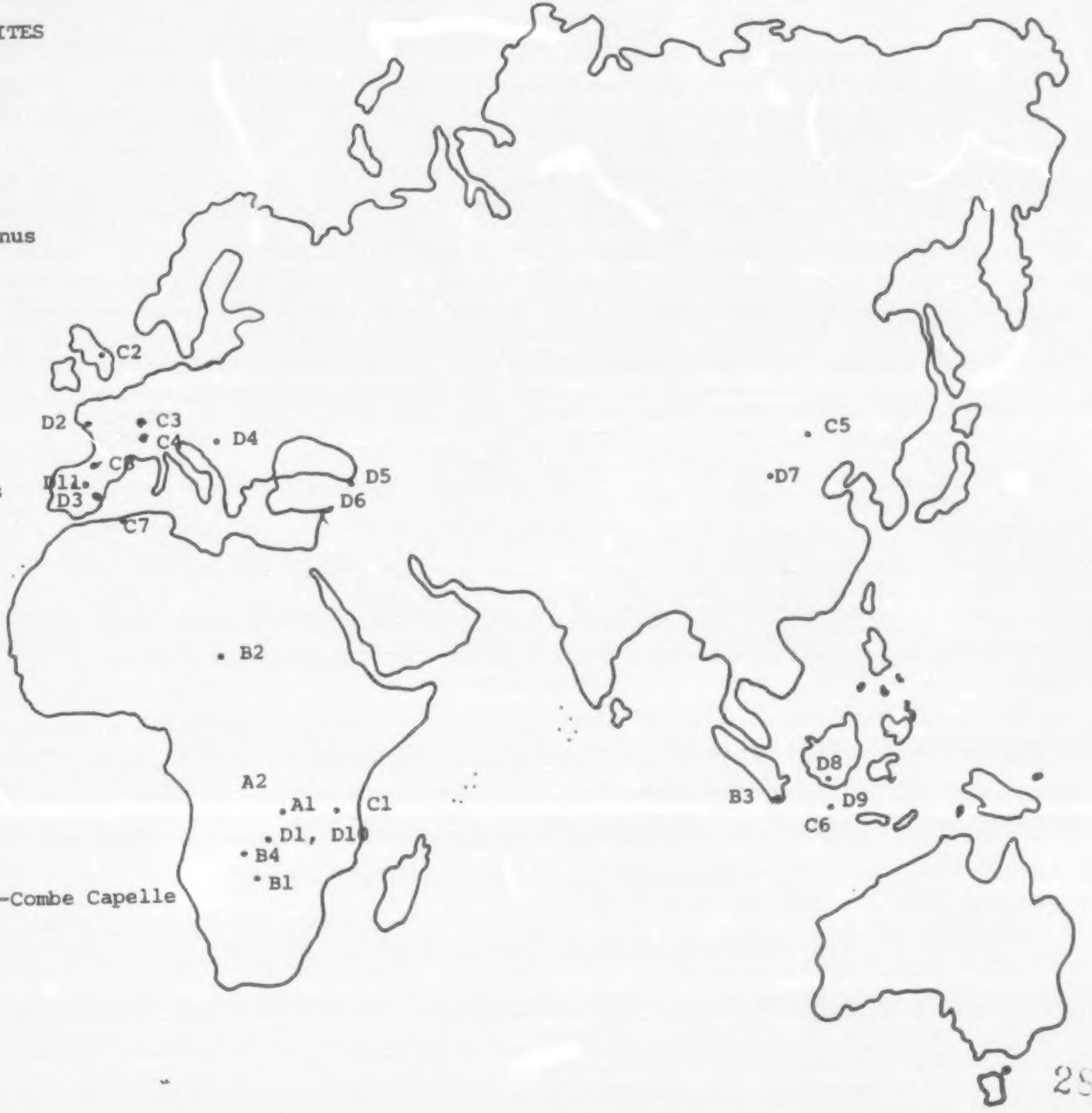
LOCATION OF FOSSIL MAN SITES

Upper Pliocene
A1 . . . Homo habilis
A2 . . . Zinjanthropus

Lower Pleistocene
B1 . . . Australopithecus africanus
B2 . . . Tchad
B3 . . . Modjokertenis
B4 . . . Telanthropus

Middle Pleistocene
C1 . . . Chellean-3
C2 . . . Swanscombe
C3 . . . Steinheim
C4 . . . Heidelberg
C5 . . . Homo erectus pekinensis
C6 . . . Homo erectus erectus
C7 . . . Ternifine
C8 . . . Fontechevade

Upper Pleistocene
D1 . . . Rhodesian Man
D2 . . . Cro-Magnon-Chancelade
D3 . . . Grimaldi
D4 . . . Bruun-Predmost
D5 . . . Shanidar
D6 . . . Mt. Carmel
D7 . . . Choukoutein
D8 . . . Wadjak Man
D9 . . . Solo Man
D10. . . Saldanha
D11. . . La Chapelle Aux Saints-Combe Capelle


C2
D2
C3
C4
D4
C8
D11
D3
C7
D5
D6
C5
D7
B2
A2
A1
C1
D1, D10
B4
B1
D8
B3
D9
C6

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OLD WORLD PREHISTORY

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THE DEVELOPMENT OF MAN AND HIS CULTURE:
OLD WORLD PREHISTORY

Teacher Background Material

Grade Five

OLD WORLD PREHISTORY

Introduction

The preceding chapter presented the fossil evidence for human evolution. A similar account of the evolution of other animals and plants is not only possible, but would comprise their total history. With man, this is not the case. The development of man is unique because of the emergence of his capacity for culture.

Culture. Culture is the way of life of a group of people. All of the capabilities and habits acquired by man as a member of society are included in his culture. Language, social relationships, and technology are all part of culture.

Culture and Adaptation. Man and all other forms of life adjust to their environment through biological adaptation; but man alone has culture as an additional means of adjusting to his environment. Man did not have strong teeth or claws with which to protect himself; neither did he have the great speed necessary to flee from his enemies. Instead of these specialized adaptations, man learned to make tools and weapons and developed language which has enabled him to communicate and pass on knowledge from one generation to the next. Only man has a cultural history.

Cultural History. Man did not suddenly acquire a specialized brain and begin to speak and make tools. Instead, culture developed over an immense span of time during which the physical changes described in the preceeding chapter also took place. One of the major contributions of the science of anthropology is the emphasis on the study of man both as an animal and as a cultural being. This chapter will deal with this second aspect of man--his history as a cultural being.

Tool Making and Tool Traditions

Tool Making and Tool Using. From the archeological record, it is almost as difficult to determine when culture began as it is to determine which was the first fossil man. Evidence of most aspects of culture does not survive to be discovered by archeologists. The major exception is evidence of toolmaking. It is generally agreed that man is the only animal who makes tools. On occasion, animals such as the great apes have been observed using objects as tools, but such activity is limited to attaining goals which they can directly see. The systematic making of tools requires a degree of foresight and planning not possessed by non-humans. The existence of tools made according to a pattern is considered a sign of man and of human culture. In addition to comparative anatomy, as discussed in the last chapter, the criterion of patterned toolmaking is used by archeologists to determine whether fossil finds represent man.

The distinction between tool-using and toolmaking must not be drawn too sharply, for toolmaking only gradually emerged from tool-using. Even today, natural objects such as sharp stones, teeth, and shells are frequently used by the Australian tribesmen. The earliest tools made by man--

or manlike creatures--are very crude and difficult to distinquish from natural objects. Then, too, many of early man's tools did not survive to be discovered by archeologists. Tools made of wood, bone, and horn, all decay.

Tool Traditions. Only stone tools are relatively impervious to destruction, and for this reason our knowledge of man's earliest history is limited to the type of stone tools he made. Archeologists prefer to speak of early man's toolmaking traditions, rather than his culture, because culture implies the total way of life of a people. A toolmaking tradition is a set of habits for making a certain tool in a particular way. As a result, such tools resemble each other, conforming to a set pattern. It is this pattern in toolmaking that identifies tools as man-made. During the first and longest stage of man's history, he utilized chipped stone tools. This stage is called the Paleolithic or Old Stone Age. This period is further divided into three parts: Lower Paleolithic, Middle Paleolithic, and Upper Paleolithic.

Lower Paleolithic Toolmaking Traditions

In the earliest part of the Paleolithic Age (see the chart on the next page), there are two basic types of chipped stone tools, core tools, and flake tools. Both types of tools were made in essentially the same manner. First a stone was hit with another stone or club, thereby removing a flake from the side of the first stone. The removal of such flakes left a sharp cutting edge on the remaining part of the stone, the core. The core then constituted a tool. This is called a core tool. The sharp flake of stone that was removed from the core could also be used as a tool. This is called a flake tool. There are different types of both core and flake tools. Some examples of core tools are pebble[1] tools, hand axes, and chopper tools.

Core Tools. The earliest toolmaking tradition in Paleolithic times is that of the pebble tools which appeared in Africa before the second glaciation (Mindel). These tools have been found in association with fossils of Australopithecus, but some anthropologists do not believe that there is yet sufficient evidence to give Australopithecus credit for the first patterned tools. Part of the doubt exists because there are several different types of Australopithecus as was discussed in the last chapter. It is very probably that the more manlike Australopithecus, such as Homo habilis, did make and use tools. These tools may have even been used by Homo habilis as weapons against other Australopithecus, such as Zinjanthropus, (See pages 3-4 in the chapter on Fossil Man).

From the evidence of Olduvai Gorge, Tanzania (formerly Tanganyika), where pebble tools are found in a stratified sequence, it would appear that the first great advance in man's culture took place in east central Africa. Although the pebble tools in the lowest level of strata at Olduvai are difficult to identify as man-made, the higher and more recent levels show steady improvement in toolmaking technique. The early tools from the base level are known as the Oldowan stage of toolmaking. A few flakes were removed from one end of a pebble, thereby leaving a broad edge suitable for cutting, scraping, or chopping.[1] As time went on the pebbles were chipped more extensively on both sides so that they became pear-shapred in outline with a point and a sharp margin all around the edge. These tools represent the beginning of the hand axe tradition which in its earliest stages is called Abbevillian.

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[1] "Pebble" does not mean pea gravel; it refers to a water-worn stone which might be several inches in length and diameter.

By the second intergalcial period a more efficient hand axe tradition called Acheulian had developed. The Acheulian hand axes were roughed out with a hand hammer stone, as were the Abbevillian **axes.** They were finished by striking the axe with a bone or wooden stick, thus removing smaller, shallower flakes. As a result, the Acheulian hand axes are smoother with a more even cutting edge.

The hand axe was the first standarized implement. It was an all-purpose tool, used for all types of cutting and scraping. It was not mounted on a handle, but held in the hand. Although the early Paleolithic hunters also used stone flakes for tools, the hand axe was the predominant tool in Africa and Europe for several hundred thousand years. The hand axe was basically the same in all areas, but there were important regional differences even at this primitive technological level. The hand axe did not spread further than northwest India. Farther east, the early pebble tool tradition developed into a chopper-type tool tradition which apparently was never replaced by the hand axe. The chopper tool differed from the hand axe. It had a broad edge like a true axe or a meat cleaver rather than the pointed end of the hand axe.

The process of making core tools was wasteful of both time and material. Only one core tool could be made from a stone. No doubt this is why flakes from making core tools were also used by most Paleolithic peoples.

Flake Tools. The use of flake tools became increasingly important as the Clactonian tradition developed in Europe during the second interglacial period. The Clactonian technique involved the removal of flakes of stone from a core in the same manner in which flakes were removed to make the Abbevillian hand-axe. But unlike the hand-axe peoples, the Clactonians laid greater stress on making tools of the flakes rather than of the cores.

During the third glaciation (Riss), a further step came about in flake tool development. The Levalloisian technique involves shaping a stone core in such a way that a large flake, resembling a flat, finely worked hand-axe, can be struck off. This flake is a tool requiring little or no finishing. It has a sharp fine edge and makes an excellent skinning knife. The pre-shaped or prepared core technique may have been invented independently by more than one group of Paleolithic people. In Africa,

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[1] A detailed description of the different methods of working stone can be found in Kenneth P. Oakley's Man the Tool-Maker

Levalloisian flakes appear with Acheulian hand axes. But the Levalloisian technique proper apparently arose later, and in Europe it replaced the typical Acheulian culture at the time of the third glaciation.

Although the use of flake tools became increasingly important as time passed, most peoples throughout the Lower Paleolithic used both flake tools and core tools. The difference was one of emphasis, not the use of flake as opposed to core tools. In one form or another, the Levalloisian tradition persisted strongly in Europe throughout the third interglacial period and during the first stage of the fourth glaciation. In some parts of Europe, Africa, and Asia, Levalloisian methods lasted to the end of Paleolithic times.

Life in Lower Paleolithic Times

It is difficult to try to reconstruct what life was like in Lower Paleolithic times because the archeological record is weakest for this first and longest period of man's prehistory. However, there is sufficient evidence for anthropologists to describe in general a representative way of life for the men of the Lower Paleolithic. During this period the earth was inhabited by two different forms: Australopithecus and Homo erectus.

Years Ago	Geologic Time	Fossil Man	Tool Tradition
Less than a million to 1.75 million	Lower Pleistocene to Upper Pliocene	Australopithecus	Pebble Tool (Oldowan)

Australopithecus. The various species Australopithecus lived in much the same manner in the bushy country on the edge of the forests. The climate of that time was warm and mild, so survival against the weather should not have been difficult. Some species probably lived primarily on vegetation while others included meat in their diet. The earlier Australopithecus was probably capable of catching and killing only small animals or the young of larger animals. But as time went on they successfully caught larger animals. This increasing success was probably a result of better tools and increased cooperation in hunting. This is inferred from the remains of animals so large that cooperation of several hunters would seem to have been necessary. Initially, tools were probably limited to natural objects such as stones, sticks, and clubs. Only later did they begin making tools, such as pebble tools. Australopithecus probably lived in small bands, composed of a few adults of both sexes and their offspring.

Years Ago	Geologic Time	Fossil Man	Tool Tradition		
190,000	3rd Glaciation				
	2nd Interglacial			Levalloisian Flake Tools	
			Acheulean Core Tools		
480,000	2nd Glaciation	Homo erectus		Clactonian Flake Tools	Chopper Tools (Homo erectus pekinensis)
	1st Interglacial		Abbevillean Core Tools (Hand axe)		
600,000	1st Glaciation				

Homo erectus. Sometime between the development of the pebble tool tradition of Australopithecus and the development of the hand axe tradition, Homo erectus appeared (see pages 4-5 in the chapter on Fossil Man); the place and time are presently unknown. Many archeologists believe that it was somewhere in east central Africa because there the progress in toolmaking was most rapid. The hand axes of Europe and Africa and the chopper tools of Asia were all probably made by Home erectus.

The earliest culture clearly belonging to Homo erectus has been found at Choukoutien near Peking, China. This is the culture of Homo erectus pekinensis (Peking Man), which existed during the second glaciation (Mindel) at a time contemporary with the African hand axe tradition. It constitutes the best evidence yet found of how man lived in the lower Paleolithic Age.

The artifacts and fossil remains of Peking Man are relatively well preserved since he lived in a cave. He is the earliest man known to have used fire. It would have served to warm his cave, to protect him from wild animals, and to cook his food.

The basic tool found in association with Peking Man is a chopper. Many of these are so crude they would have been unrecognizable as tools if they had been found on the open ground unassociated with other evidence of human habitation. The tools were made of quartz which was probably brought to the cave from a site about five miles away. This indicates Peking Man was searching for the best materials from which to make his tools. In addition to chopper tools, Peking Man probably used a sharply pointed fire-hardened spear as a weapon. No evidence of such a spear has been found at Choukoutien, but wooden objects would not have lasted hundreds of thousands of years. The Lower Paleolithic hunters would have required some weapon better than the hand axe or chopper tool, and evidence from other sites indicates that a wooden spear was one of the most primitive weapons used by man. With such a weapon, the African pygmies of today manage to kill elephants.

Peking Man was a fairly successful hunter. Judging from the animal remains at Choukoutien, his diet consisted largely of venison. He also killed large herbivores, such as elephants, and carnivores, such as saber-toothed cats and cave bears. Some of the animal remains indicate that Peking Man utilized pit-traps as another means of killing game. In addition to meat, Peking Man probably ate large amounts of wild seeds and berries. The seeds of a kind of wild cherry were found in the habitation site at Choukoutien, but most evidence of plant food would have decayed.

It is also probably that Peking Man was, on occasion, a cannibal. The skulls of his fellows have been found with the base openings enlarged as if to extract the brains and the long bones split as if to extract the marrow. If these remains do represent cannibalism, it is impossible to know whether this was part of a ritualistic practice or simply a case of necessity. The absence of any burials or other evidence of ritualistic practices again leads to speculation. Did all evidence vanish long ago, or does the absence of evidence indicate that Peking Man and other Lower Paleolithic peoples had little or no ritualistic practices? It is impossible to say.

It is also impossible to determine the number of people who lived at Choukoutien or their relationship to each other. By observing hunting and gathering groups of today, anthropologists have learned that only a small group of hunters can live together. Larger bands cannot find enough food in one place and must split into smaller groups. Peking Man's group was probably organized on a kinship basis, as are most hunting and gathering groups, but anthropologists have no way of knowing. A high degree of social cooperation would have been required to enable Peking Man to kill large game animals with primitive weapons. Anthropologists assume Peking Man had developed such cooperation.

The way of life of all Lower Paleolithic hunters was probably not noticeably different from that of Peking Man, except that some such hunters might not have had fire. The gradual improvement of core and flake tools throughout the Lower Paleolithic did not involve any major innovations which prompted important changes in hunting methods or way of life.

Middle Paleolithic (Mousterian)

Years Ago	Geologic Period	Fossil Man	Culture
40,000	1st part of 4th glaciation	Homo sapiens neanderthalensis Homo sapiens spaelus	Mousterian

NOTE: *Homo sapiens spaelus* appears to have existed before *Homo sapiens neanderthalensis* as well as contemporaneously. But the Middle Paleolithic is best known from the Mousterian culture of *neanderthalensis*.

During the fourth glaciation (Wurm) man's progress began to accelerate. At this time Europe was inhabited primarily by *Homo sapiens neanderthalensis* (Neanderthal Man). He developed a culture called Mousterian which is sufficiently advanced to be classified as Middle Paleolithic. (Neanderthal Man is described in the chapter on Fossil Man.)

Stone tools used by Neanderthal Man were only slightly advanced over those used by Peking Man. The tools were limited to scrapers, points made from flakes, and small hand axes. There were no specialized spear points and Neanderthal Man made little use of horn or bone tools. Apparently, there was no marked change in hunting methods, and the wooden spear continued as the major weapon. Mousterian culture is significant because of the increasing range of settlement and scope of ritualistic practices.

Neanderthal Man successfully extended the range of human settlement well to the north of the frost-free zone. Exactly how he was able to do this during a time of glacial intensity is not known. He occupied caves whenever possible, used fire, and probably wore animal skins for clothing. The use of animal skins for clothing is indicated by numerous well-made flint scrapers, left in habitation sites, which would have facilitated the dressing of skins.

A second advance shown by Neanderthal Man was the first known burial of the dead. These burials sometimes contained food or other objects, indicating some type of burial rites. Bear skulls have been found arranged in a special order, suggesting that Neanderthal Man had developed concepts well beyond what might be expected from men with a material culture only slightly improved over Lower Paleolithic cultures.

Upper Paleolithic Cultures

Years Ago	Geologic Period	Fossil Man	Culture
10,000	Last part of 4th glaciation (Wurm)	Homo sapiens sapiens	A variety of cultures, most of which made tools from stone blades.
40,000			

The Upper Paleolithic cultures are best known from sites discovered in Europe. Here techniques belonging to the Upper Paleolithic abruptly succeed the Mousterian culture. The beginning of the Upper Paleolithic coincides with the disappearance of *Homo sapiens neanderthalensis* and the appearance in Europe of *Homo sapiens sapiens* or modern man. (See the chapter on Fossil Man.)

Modified Lower Paleolithic traditions continued to exist in some areas until comparatively recent times. Both in Africa, where Lower Paleolithic techniques were first developed, and in Asia, where chopper tools developed, the further improvement of tools did not parallel the major development of blade tools of the European Upper Paleolithic.

During the Upper Paleolithic, Europe was undergoing the last of the fourth glaciation. The weather in Europe, northern Asia, and northern America was still bitterly cold. Only people with advanced methods of hunting and who had protection from the cold could live in these areas. Neanderthal Man, who lived in caves and had fire, was the first to move into these cold areas. Men who came after Neanderthal Man also lived in caves and had fire, but he had improved weapons and equipment which enabled him to expand into areas not reached by Neanderthal Man. Siberia became inhabited for the first time late in the fourth glaciation, and men then moved across the Bering Straits into America.

Lower Paleolithic hunters had only a limited number of tools--cutting tools, scraping tools, and wooden spears. Upper Paleolithic man had a larger tool kit and owned greatly improved weapons. This variety of tools and weapons was made possible by the discovery of new techniques for working stone.

Blade Technique. One of the most important developments of the Upper Paleolithic was a technique for producing long flakes of stone shaped like blades. First, a core was prepared with a flat top and straight sides like a shotgun shell. A bone punch was placed near the edge of the flat top and hit with a club or stone hammer. The force of the blow split off a long stone blade with two sharp sides which curved together to make a rounded sharp point. Many such blades could be struck in rapid succession from the same stone core until almost nothing was left of the core. This technique produced many blades from a limited amount of stone.

These blades were then shaped into different types of tools by pressure flaking. Instead of knocking off a chip of stone, as was done previously, a bone tool was pressed against the edge of the blade and a chip was pressed off. This more precise technique enabled Upper Paleolithic man to make a variety of tools from the basic blade. Such tools included concave scrapers for shaping wooden spears, convex scrapers for cleaning skins, awls for drilling holes in wood or bone, and burins, small chisels for working wood and bone.

The invention of the burin could be termed revolutionary for Upper Paleolithic man. With this tool, for the first time, man could make extensive use of horn and bone for tools and weapons. Lower Paleolithic man had no tool that he could use to cut efficiently and shape bone or horn. The burin was one of the first tools designed to make other tools. Upper Paleolithic man could now make harpoon heads to fit the ends of his spears. Such bone points are more durable than both the wooden tipped spears of Lower Paleolithic man and the flint pointed spears of early Upper Paleolithic man. Also, bone tips will not break if they strike bone, as will flint tips.

Burins enabled man to make another important tool, the bone or horn needle. With this simple tool Upper Paleolithic people were able to sew warm animal skins together into fitted clothing. A warm cave and fire were not enough to enable man to live in the north during a glaciation, for he had to go out to get food. Neanderthal Man may have had some type of clothing. His clothing was probably clumsy, more like a cloak, since he did nor have a needle to sew fitted clothing.

Tools and Environment. The making of fitted clothing illustrates that the kind of stone tools which man possessed determined, to some extent, where he could live. The new stoneworking techniques of blade production and pressure flaking of the Upper Paleolithic enabled man to make a variety of stone tools. These, in turn, made it possible for him to make a bone needle; he could then sew the warm clothes he needed to live in the north. The ability to make tools and to secure food began to improve rapidly during the Upper Paleolithic. Each new type of tool permitted man to work more efficiently.

Life in the Upper Paleolithic. There is no evidence that any Lower Paleolithic peoples attached points to their wooden spears, but Upper Paleolithic men made both flint and horn points for their spears. Spears with such points were more effective in killing game than the fire-hardened spears. Another invention, the spear-thrower, was a great help to the hunter. The spear thrower is a piece of wood or bone about two feet long. At one end are holes or notches for a man's hand, and at the other end there is a peg or pit which engages the end of the spear. This spear-thrower serves as an extension of the hunter's arm, enabling him to throw the spear with greater force. The Arunta of Australia are an example of contemporary tribesmen who still use the spear-thrower.

Even with these improvements in weapons, Upper Paleolithic man probably did most of his hunting by stalking an animal until he was close enough to throw his spear, just as did Lower Paleolithic man. However, Upper Paleolithic man also developed some new means of capturing game: nets, specialized traps, and animal drives into natural corrals or over cliffs.

From the animal drive, archeologists infer that Upper Paleolithic man had developed social cooperation involving more than one hunting band. There is no way of knowing exactly how man hunted or lived, but it is possible to make assumptions based on what is known about contemporary hunting peoples. As long as man hunts by stalking, only a few hunt together. The availability of food in an area limits the size of the group to a band of approximately five to ten adults. It would be impossible for such a small group to drive herds of animals over a cliff. It is therefore concluded that different bands of hunters gathered in a suitable place to organize and carry out a drive.

From these assumptions, it is possible to speculate how Upper Paleolithic man lived. The basic group was a small band of hunters, probably organized like a large family. This group lived in a cave. They probably left the cave during part of the year and lived in shelters made of animal skin. In areas where there were no caves they constructed semi-subterranean houses with roofs made of animal skins. These are the earliest artificial shelters yet found by archeologists. Probably in the fall, judging from the animal remains, various bands would gather for a short time in order to drive animals over cliffs or into natural corrals. After the hunt, each band would return to its own area for the winter. As yet, no evidence has been found of such large animal drives in the Lower Paleolithic. Therefore, it is probable that man did not gather in large groups before the Upper Paleolithic.

The more advanced technology of the Upper Paleolithic enabled man to spend less time in the daily search for food. Only people who have an adequate supply of food can spend much time in activities that do not produce food. During the Upper Paleolithic, a great amount of embellishment was applied to objects of daily use, such as spear-throwers. More spectacular than tool embellishment are the numerous paintings and engravings that Upper Paleolithic man applied to the walls of caves. Since these paintings are frequently found in deep caverns, difficult to reach, it is probable that they were an important part of ritualistic practices designed to insure successful hunting. In many areas, Upper Paleolithic man made small female figurines in which the sexual characteristics are emphasized. According to some archeologists, such figurines indicate the existence of fertility cults. Elaborate burials suggest that Upper Paleolithic man, like Neanderthal Man, was concerned with the problem of life and death. None of these signs of art and ritualistic practices have been found in the Lower Paleolithic, but they are characteristic of man since the Upper Paleolithic.

Mesolithic

Years Ago	Geological Time	Fossil Man	Cultures
Approximately 10,000	End of Pleistocene and beginning of Holocene	Homo sapiens sapiens	A variety of cultures

NOTE: A time span in years cannot be given for the Mesolithic for it began earlier in the south than in the north and ended only as Neolithic traits gradually diffused.

End of the Pleistocene. The end of the Pleistocene and beginning of the Holocene was a critical period in cultural change, due to climatic changes and accompanying changes in flora and fauna. During the latter part of the Upper Paleolithic, the fourth glaciation gradually ended as the climate grew warmer. The larger Pleistocene animals, such as the mammoth, died out; the reindeer, upon which the Upper Paleolithic man had depended, moved northward; forests began growing farther north; and the smaller game animals of modern times, such as the red deer, became numerous. With these changes Upper Paleolithic cultures ended and Mesolithic or Middle Stone cultures began. The name Mesolithic indicates that this is a transition period between the Paleolithic and Neolithic Ages.

Mesolithic Cultures. Artistically, the Mesolithic cultures of Europe were inferior to those of the Upper Paleolithic. There was almost no continuation of the artistic traditions of the Upper Paleolithic. The necessity of adjusting to the changing environment probably precluded the more stable life which characterized the Upper Paleolithic culture. Technologically, however, the Mesolithic made important advances.

Technological improvements by Mesolithic peoples included improved tools and weapons, based on a modification of the blade technique developed in Paleolithic times. Instead of using a whole blade, small sharp pieces of blades, called microliths (small stones), were set in the handle or shaft of the tool or weapon. These microliths were developed in the late Paleolithic, but became increasingly important in the Mesolithic.

An important new tool was the stone axe for woodworking. This was a true axe with a broad cutting edge designed to be mounted on a handle. It was unlike the hand held, pointed hand axe. Now man could utilize the wood of the forests for construction material.

New tools helped make possible the adoption of new methods of hunting and gathering. The bow and arrow came into general use in the old world, with a microlith serving as the point of the arrow. Boats were developed, and permitted wider use of water resources. Shell fish became an important food source. Invention of the true fishhook made line fishing possible. Fish were taken by spearing, as in former times, and also by hook and line, nets, and fish traps. The dog also became man's hunting companion.

Limitations of Hunting and Gathering. As Mesolithic hunting and gathering peoples spread into all parts of the world, they learned to use all locally available animal and plant food. However, as long as man was restricted to gathering natural foods, his total culture was extremely limited. A hunting and gathering economy could support only small groups of people in a given area. As game animals moved, or different natural plant foods ripened, man had to move. There are very few areas in the world where hunting and gathering peoples have been able to live in permanent settlements. It was not until man became a food producer that he could settle permanently or live in large groups. This transition from hunting and gathering to food producing is considered a key step in man's cultural development.

The Neolithic Revolution--Food Production

The transition from food gathering to food production occurred in the seventh millenium B.C. in the Near East. The term "Neolithic" or New Stone Age was applied to this period by early anthropologists in the mistaken belief that the introduction of polished stone tools was the most significant cultural innovation. The significant aspect of the Neolithic, however, is the development of a culture in which man began to plant and breed his food instead of relying on hunting and gathering techniques. This is the first basic change in human life, and Professor Childe rightly calls it the "food-producing revolution." This revolution alone made possible the development of literate civilizations and remains the most important single step in man's history.

Gradual Development of Food Production. Discussion of a "Neolithic revolution" should not obscure the fact that this, like all other stages in human progress, took place slowly. The earliest steps toward domestication of plants probably took place somewhere in the area from Palestine to the piedmont zone of Turkey and the Caspian Sea. Even today, in these upland areas, wild wheat and barley of the type man first domesticated are found, and the rainfall is adequate for dry farming.

As the fourth glaciation ended, the weather in Africa and the Middle East gradually became dryer. It seems likely that under these conditions one, or perhaps several, groups of Mesolithic hunters and gatherers came to depend more and more on natural wild grain for food. They gradully learned not only to use grain, but to help it grow, and finally, to plant it. At the same time, they were learning to domesticate animals such as goats. The first steps in this sequence would have left little trace in the archeological record. Only the last step, the successful application of domestication, has left a record for archeologists to find.

Jericho and Jarmo, Two Neolithic Sites. Although archeologists have not learned exactly where domestication began, they have discovered several sites in the Near East that indicate stages in its development. Excavation at Jericho in Jordan show that around 7800 B.C., well before the biblical city was built, a small group of people lived around a spring. This group probably contained only a few families, hunter-fishers of a culture called Natufian. They supplemented their diet by harvesting grain with a reaping knife whose cutting edge consisted of microliths set in a handle.

These early inhabitants of Jericho seem primarily hunters, but later inhabitants of the area show definite progress toward a settled way of life based on hunting, and the gradual domestication of cereals and goats. Increased food supply resulted in growth in the size of the settlement. The people built houses of mud brick and fortified their community with a protective wall. This indicates that neighboring peoples were at a comparable stage of development--if the inhabitants of early Jericho felt the need of a protective wall.

A site at Jarmo in northern Iran tells a similar story. The people here were also gradually changing from Mesolithic hunters to Neolithic food producers. A study of the animal bones from the upper strata of Jarmo reveals that only five per cent of the animals eaten were wild. In addition to goats and sheep, they had domesticated cattle and swine. The stone tools used at Jarmo also indicate that the culture was in the process of changing from Mesolithic to Neolithic, for Mesolithic microliths were found as well as polished stone axes. Pestles, mortars, and milling stones indicate the importance of grain foods.

Neolithic Villages. As man's control over plants and animals grew, his way of life became increasingly secure. A herd of domesticated animals represented a greater amount of meat than a hunter could ever store. Grain foods could be saved in years of good harvest as protection against future bad harvests. This stable food supply permitted man to undertake activities not suitable for hunting peoples. It was now worth a man's while to expend a great amount of effort building a house, since he could live in it for some time. In an area which formerly produced only enough game to support a roving band of hunters, man could now grow enough food for a village. It thus became possible for man to live in larger groups.

As more people began to live in settled villages, activities difficult for migrants became increasingly important. Two of these were pottery making and the weaving of cloth. Although some hunting peoples make pots and cloth, these activities are more typical of settled peoples who probably originated them.

By 6000 B.C. Neolithic villages were widespread in the Middle East. Most of them were small and contained no more than a few dozen houses. The houses were made of mud walls on a rock foundation, and contained only two or three small rooms. Each probably housed only one family. Such villages usually contained a larger group of people living permanently together than could be formed by hunting and gathering people.

No doubt most of the inhabitants of the early villages helped tend the herds of sheep, goats, cattle, and swine, and shared the work of cultivating the fields of grain. This is indicated by the lack of specialized structures, such as temples, in these early villages. However there probably were certain people who functioned specifically as village leader or ritual director. There is also evidence that some people were beginning to specialize in different crafts, one of which was pottery making. The only clues concerning the ritualistic beliefs of these early villagers come from small figurines of animals and humans. According to many archeologists, these figures indicate a type of fertility cult concerned with the multiplication of herds and crops.

Neolithic villages were in a sense similar to the modest villages of peasant farmers that can be seen in many parts of the world today. These early Neolithic farmers are important because they lived in a settlement, could store food to eat in times of famine, and provided some base for craft specialization. These simple villages were the foundation for the development of urban society.

Although the Neolithic Revolution first occurred in the Near East, the American Indians independently domesticated plants at a later date. Some archeologists believe independent domestication of plants also took place in Asia.

The Urban Revolution in the Bronze Age

Between 6000 and 3000 B.C., some Neolithic villages gradually grew into urban centers. These urban centers were characterized not only by increase in size, but by a change in patterns of living. Neolithic farmers lived similar lives, but diversity was the mark of the urban centers. There were skilled artisans of all types: merchants, soldiers, priests, and rulers. Goods from distant places were traded in the market; ideas and techniques from other areas were brought back by traders. New discoveries and inventions increased, and the development of writing facilitated the accumulation and spread of knowledge.

The growth of literate urban societies from Neolithic villages was a result of many changes that took several thousand years to crystallize. The most important of these were: increase in agricultural production, specialization, growth of central authority, and trade.

Increase in Agricultural Production. The Neolithic farmers had produced a surplus of food, but many such farmers had to produce a great surplus before a city composed of non-farmers could develop. The first step in this direction was taken slightly before 5000 B.C. when Neolithic farmers moved from the hills of northern Iraq to the Tigris-Euphrates river valley. Here the soil was very rich. By learning to irrigate their fields and discovering how to harness to a plow the domesticated cattle, it was possible for these river valley farmers to produce great surpluses of food.

The existence of a food surplus enabled men to experiment with new ways of doing things. When men have only a little food to spare, they cannot risk trying new methods that might fail. But with a surplus, even if some new methods fail, the community does not suffer. When the new methods prove more efficient, the entire community benefits.

Specialization. Specialization in crafts, such as pottery, had already begun in the Neolithic villages, but the increasing food surpluses made it possible for the farmers to feed a larger group of full-time specialists. As a result, craftsmen who specialized in one product were able to make more and more improvements in their products. Also, groups of non-farming workers could be fed while working on such public projects as irrigation canals, enterprises that were of benefit to the entire community.

Central Authority and Religion. Some central authority was needed to direct these public projects. This authority was probably vested in the priests of the local temple. These early river valley settlements were only large villages, but they were already distinguished by the existence of a temple. The earliest temple yet found was a small square room with screens used to divide the inner space, an alter in a niche in the rear wall, and an offering place showing signs of burning. Insignificant as this small temple may seem, it indicates a more complex social organization than existed in the Neolithic villages having no specialized buildings. The temple, with its priestly ruling class, was characteristic of the early river valley cities. As time passed, the temples became larger and richer until they reached the size of the immense stepped pyramids, called the Ziggurats.

Trade. Early river valley structures had mud walls. Later, brick was the chief building material of the early cities. Stone and wood, needed both for building and toolmaking, had to be brought into the valleys from other areas. The cost of bringing these materials to the valleys was met by the food surplus produced by the farmers. Before such an exchange of food and labor could take place, efficient methods of transportation had to be developed.

The ox-drawn sledge may have been the first animal-powered means of transportation, but it was soon superseded by the wheel. No one knows where the wheel was first invented, but wheeled carts appeared in Sumerian art by 3500 B.C. The wheel greatly simplified the problem of transporting goods by land. The wheel was also applied to other tasks such as making pottery, and the potter's wheel greatly increased the quantity and quality of pottery one man could produce. At the same time the wheel was being perfected, or even earlier, developments were being made in water transportation. By 3000 B.C. sailboats were used to transport goods in the eastern Mediterranean.

Metal Tools. The widespread use of metal tools illustrates that agricultural production, specialization, central authority, and trade were directly related to the growth in technology. Food surpluses permitted experiments with new methods, and the increase in trade spread knowledge of new methods throughout the Near East and beyond. Technology rapidly increased as each new development stimulated and made possible further developments.

Some Neolithic village peoples had discovered how to make copper tools, but copper tools were never widely used. Copper, alone, does not make satisfactory tools, but when copper is combined with tin, the alloy bronze is produced. Bronze is both stronger and easier to work than copper, but tin and copper are rarely found in one place. The production of bronze tools usually requires mining tin at one site and copper at another. The ore must be smelted to produce the metal, and the tin and copper must be brought to a central site where bronze tools are made.

All of this requires good transportation, many specialized craftsmen, and food surpluses. A political unit must be developed which is strong enough to regulate the population, and to protect trade routes and sources of raw materials. An urban society develops.

The Bronze Age. The establishment of urban society around 3000 B.C. marks the end of the Neolithic Age and the beginning of the Bronze Age. This term does not imply that the most important aspect of these early urban societies was their bronze tools, any more than the use of the term Neolithic implies that polished stone tools were more important than the production of food. Rather, the earlier terminology, which was used to divide man's cultures according to tool type, has been retained as a convenient label.

Far more important than tool type is the complex social structure of early urban societies. The majority of the city dwellers were not farmers who produced their own food; they were specialists of one kind or another. There were the craftsmen and traders who provided the city dwellers with the goods they needed. There were the soldiers who protected the city and its trade. Perhaps most important were the ruling authorities who insured that the necessary civic activities were carried out--the building of irrigation projects or the protection of trade. In the early cities the priests and temples occupied a central position in the administration of public affairs. Later, they shared their authority with kings who first functioned as temporary leaders, but later were established as rulers of the city states.

The problems of regulating the affairs of social units the size of cities required some innovations in methods of calculation and keeping records. Because the temples were the centers for the cities' administration, it was probable that systems of writing and mathematics developed there.

The Spread of a New Way of Life

About 300 B.C. city life had emerged. It rested on a firm agricultural base, and its government was attempting to handle the public affairs of a large population.

The development of writing marks the beginning of historical times, but history did not begin everywhere at once. The innovations of the Neolithic and Bronze Age only gradually diffused into Africa, Europe, and Asia. Egypt serves as a good example of this diffusion because this is where urban centers developed, though somewhat later than those of the Tigris-Euphrates valley. In Egypt the growth of urban life followed the same general outline as in Mesopotamia. First, hunters and gatherers began to adopt a Neolithic way of life. Exactly how farming spread to Egypt is not know, but clearly Egypt lagged behind Mesopotamia. This is best illustrated by the introduction of metallurgy into Egypt a thousand years after it was adopted in the Tigris-Euphrates valley. While the Egyptian culture showed many similarities to Mesopotamian culture, the Egyptians added their own unique features. Egypt, as well as Mesopotamia, became a center from which ideas diffused into Africa and the Mediterranean. As these ideas spread, they were modified and added to by other peoples in a continuing rapid growth of technology.

The Bronze Age ended around 1400 B.C. when iron working began, but the basis for urban society had already been laid during the Bronze Age. The Neolithic and Bronze Ages were periods of revolutionary changes, but the Iron Age was more a period of refining and expanding previous developments. For example, writing was developed in the Bronze Age, but a true alphabet was not developed until the Iron Age. Even the great Iron Age civilizations of classical Greece and Rome did not differ greatly from the Bronze Age civilizations of Egypt and the Tigris-Euphrates Vall[illegible]

As knowledge of iron-working spread, thriving kingdoms based [illegible] agriculture, use of animal power, and iron technology arose in Africa, Asia, and Europe.

Iron Age technology was not generally surpassed until the beginning of the Industrial Revolution a little over 200 years ago. During the Industrial Revolution machines began to supplement animal and man power, and rapid progress was made in all forms of technology. Urban development increased and culminated in the rise of the industrial city.

Technological Lag. Technological advances have not affected all men equally. Knowledge of new techniques has spread at uneven rates. Geographic isolation, harsh physical environment, and other factors have prevented some groups of people from advancing beyond the Mesolithic level of technology. Even today, in wide areas of the earth, the majority of people continue to live in simple farming villages not greatly different from the Neolithic villages.

Modern transportation has brought these less technically advanced peoples into closer contact with industrial societies. Like it or not, some of them are being forced to move from their traditional ways of life into twentieth century industrial society in as little as one generation. In some cases the transition has not been too difficult, but more often such change has been accompanied by social upheaval.

Improved communication is causing the world to continue to shrink. Man is more and more realizing that somehow the technological and cultural lags must be bridged. Shedding old ways is not easy, and large parts of Africa, Asia, Latin America, and even our own country are finding this out.

Understanding how cultures have changed in the past, and noting how man and society reacted and adapted to the change, can temper our view and our judgment of areas now in cultural ferment.

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A Sequential Curriculum in Anthropology

TEST FORM 5

Composite Form for Pre- and Post-Test

Anthropology Curriculum Project
University of Georgia
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DIRECTIONS

This test consists of fifty items. Each item has four possible answers. You are to read each question carefully and choose the **one** answer you think is best. On your answer sheet blacken in the space having the same number as the answer you think is best. There is only one right answer for each question. Do not write on this test booklet.

Look at the following examples.

EXAMPLES:

A. Georgia is a

1. city.
2. nation.
3. state.
4. county.

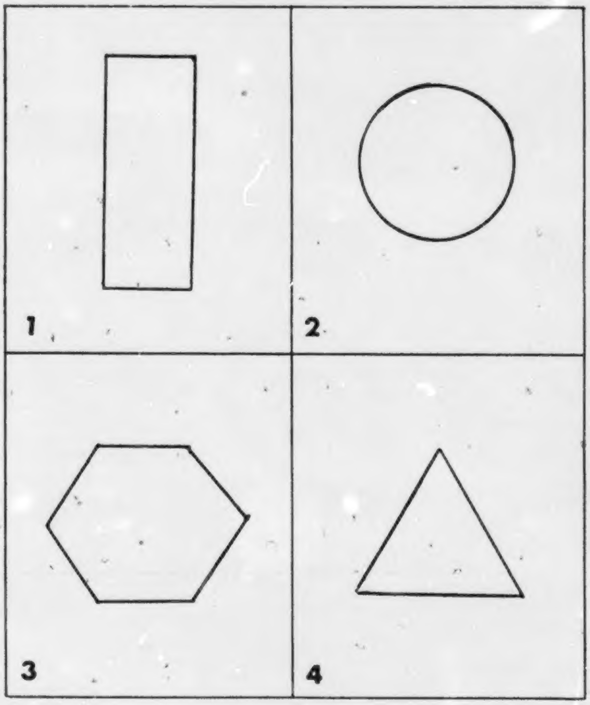
B. Which of the following is NOT an animal?

1. Doll
2. Cat
3. Kangaroo
4. Dog

C. Each of the following is a day of the week EXCEPT

1. Sunday.
2. Tuesday
3. Friday.
4. June.

Use these four pictures to answer the question below them.



D. Which of these pictures shows a circle?

1. Picture 1
2. Picture 2
3. Picture 3
4. Picture 4

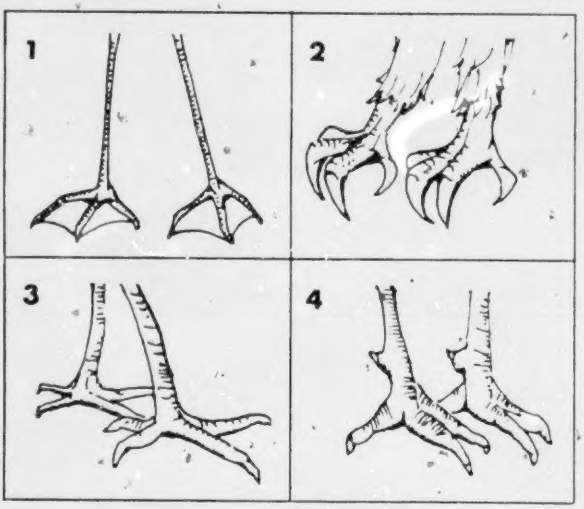
1. The central theme of anthropology is

    1. archeology.
    2. culture.
    3. geography.
    4. language.

2. Which of these is an artifact?

    1. The remains of a tree which was burned in a fire started by lightning
    2. The remains of a tree which died from lack of water
    3. The remains of a tree which was hollowed out by fire and used as a boat
    4. The remains of a tree which was split by lightning but did not burn down

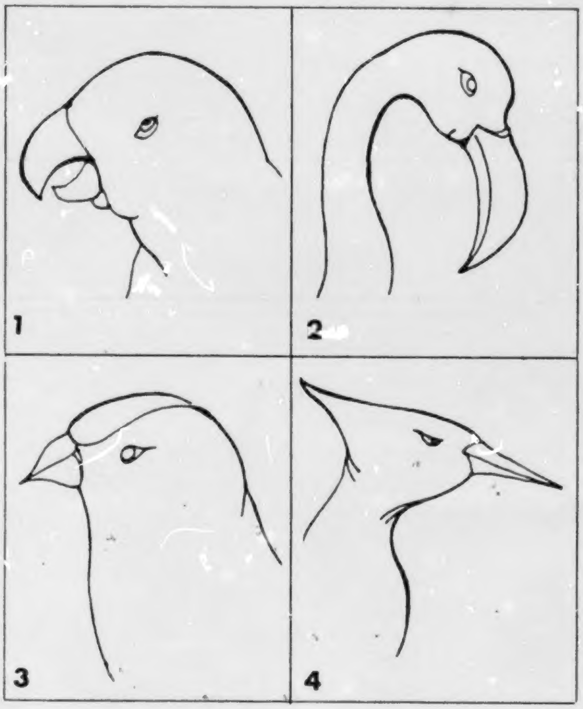
Here are pictures of the feet of four different kinds of birds. Use the pictures to answer the question below them.



3. Which of these birds would most likely be found living where the only kinds of food are plants and animals found on the bottoms of shallow ponds?

    1. Bird 1
    2. Bird 2
    3. Bird 3
    4. Bird 4

Here are pictures of the heads of four kinds of birds. Use the pictures to answer the question below them.



4. Which of these birds would be most likely to be found living where the only kind of food is insects which live in the bark of trees?

    1. Bird 1
    2. Bird 2
    3. Bird 3
    4. Bird 4

5. The FIRST stone tools were

    1. burins.
    2. hand-axes.
    3. pebble tools.
    4. projectile points.

6. During the early paleolithic period, men used tools made of

    1. bronze.
    2. iron.
    3. wood.
    4. stone.

7. The geological period called the "Ice Age" was the
    1. Eocene.
    2. Holocene.
    3. Pleistocene.
    4. Pliocene.

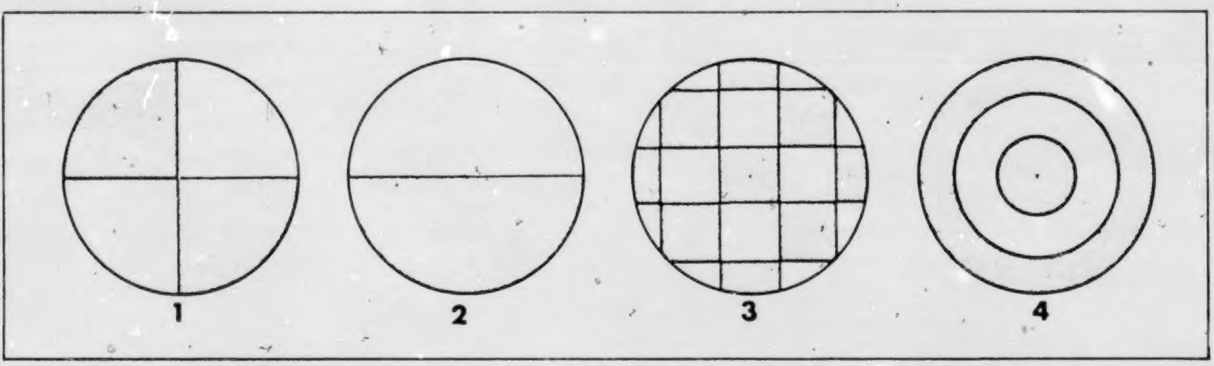
8. If you were to use relative dating on a bone, you would
    1. decide whether it is older, less old, or the same age as some other object that was found.
    2. decide whether or not it is radioactive.
    3. decide about how many years old it is.
    4. count the layers of cells in it.

9. Cultural change is MOST RAPID in which of these types of economy?
    1. Agriculture
    2. Herding and grazing
    3. Horticulture
    4. Hunting and gathering

10. Which of these is made of inorganic material?
    1. A human bone
    2. A piece of wood
    3. A leather shoe
    4. A stone spearpoint

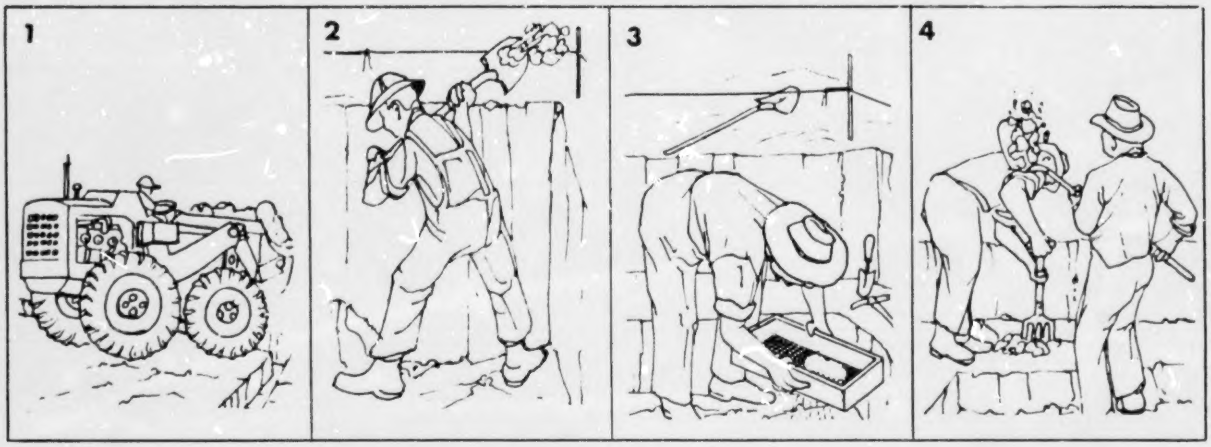
11. A theory of evolution through natural selection was worked out by
    1. Charles Darwin.
    2. Carolus von Linnaeus.
    3. Thomas Malthus.
    4. Gregor Mendel.

The drawings below show four different ways to lay off the site. The places where digging will take place have been darkened. Use the drawings to answer the question below them.



12. Which of these four methods of digging would tell you the MOST about what is buried in the site?
    1. Method 1
    2. Method 2
    3. Method 3
    4. Method 4

Here are four pictures of men digging an archeological site. Use the pictures to answer the question below them.



13. Which one of these methods of digging provides the MOST information about what is buried at the site?

    1. Method 1
    2. Method 2
    3. Method 3
    4. Method 4

14. Man is the only animal who

    1. has a brain.
    2. walks on two legs.
    3. uses tools.
    4. makes tools.

15. Which of these is a fossil?

    1. The mineralized bone of a buffalo
    2. A piece of granite
    3. A large group of trees growing close together
    4. A lake which was left after a glacier melted

16. An archeologist is

    1. a person who studies different types of animals.
    2. a person who studies the way people lived long ago.
    3. a person who studies the way the earth was formed.
    4. none of these.

17. People's habits, beliefs, and language are all part of their

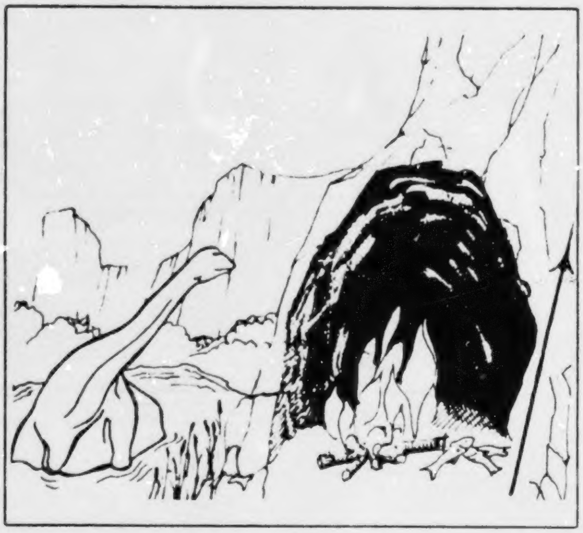
    1. culture.
    2. environment.
    3. evolution.
    4. technology.

18. Which of these places in the Old World was built BEFORE the others?

    1. Athens
    2. Istanbul
    3. Jarmo
    4. Peking

19. The type of man known as **Homo sapiens sapiens** can be found living TODAY

    1. only in Africa.
    2. in Europe and Asia, but nowhere else.
    3. nowhere on earth.
    4. anywhere on earth where people live.



20. There is something in the picture above which never has been found with all of the other things. It is the
    1. cave.
    2. dinosaur.
    3. fire.
    4. spear.

21. We live today in the geological period called the
    1. Eocene.
    2. Holocene.
    3. Pleistocene.
    4. Pliocene.

22. Peking Man is the EARLIEST man known to have
    1. hunted in groups.
    2. used fire.
    3. hunted large animals.
    4. used tools which he made.

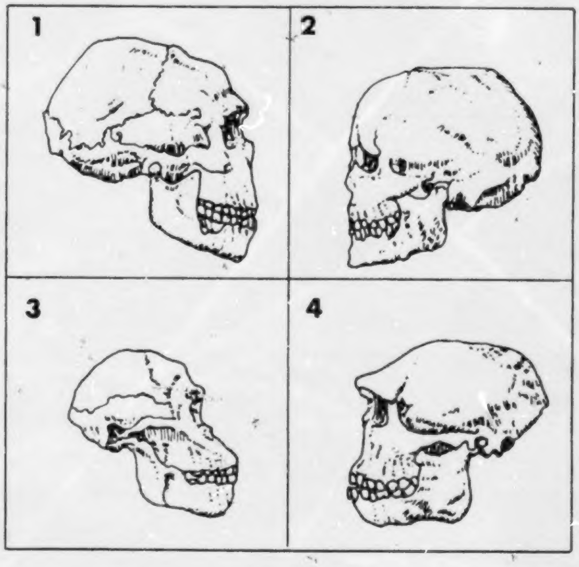
23. Which of these is true of Australopithecus?
    1. He used fire.
    2. His basic tool was the chopper.
    3. He used a pebble tool.
    4. He used a spear tipped with a microlith.

24. Which of these types of men is classified as Homo Erectus?
    1. Australopithecus
    2. Modern Man
    3. Neanderthal Man
    4. Peking Man

25. Which of these activities became more important to people AFTER they began to live in settled villages?
    1. Making of arrowheads and spear points
    2. Making of pottery
    3. Skinning and cleaning of hides
    4. Weaving of baskets

26. Which of these is a method of ABSOLUTE dating?
    1. Carbon 14
    2. Plants and animals
    3. Seriation
    4. Stratigraphy

Here are drawings of the skulls of four fossil men. Use these pictures to answer the question below them.



27. Which of these men lived AFTER the other three?

1. Man 1
2. Man 2
3. Man 3
4. Man 4

28. Here are four true statements. Which one shows that evolution has taken place?

    1. The earth travels around the sun once every 365¼ days.
    2. Horses which lived millions of years ago were no larger than dogs are today.
    3. The baby of a horse and a donkey is a mule.
    4. Today, ginkgo trees are exactly like the ginkgo trees which lived millions of years ago.

29. Suppose that you are an archeologist. A man brings you a stone axe. He tells you that he found it buried underground.

    Suppose that you could ask this man only **one** question about the axe. Which of these would be the MOST IMPORTANT question for you, as an archeologist, to ask?

    1. Where did you find the axe?
    2. When did you find it.
    3. What tools were you using?
    4. Why did you bring it to me?

30. The man who wrote that the population increased faster than the food supply was

    1. Charles Darwin.
    2. Carolus von Linnaeus.
    3. Thomas Malthus.
    4. Gregor Mendel.

31. Which of these occurred during the Neolithic Age?

    1. The dog was domesticated and began to help man hunt.
    2. Man began to produce his own food.
    3. The true barbed fish hook was invented.
    4. Chipped stone tools were invented.

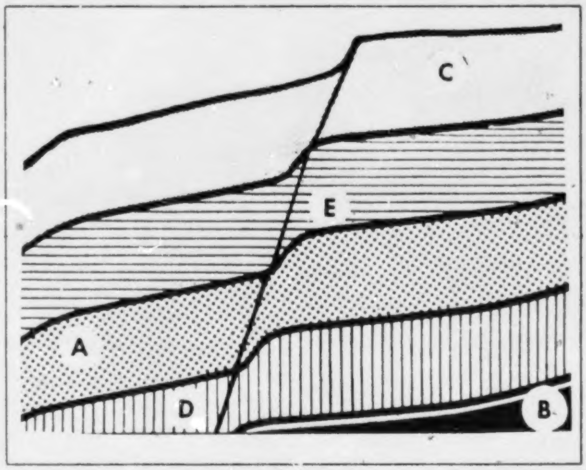
32. When men began to get most of their food by farming and by raising their own food animals, there were changes in their lives. Which of these events happened AS A RESULT of their being able to raise their own food?

    1. The boat was invented.
    2. The dog was domesticated.
    3. The people buried their dead.
    4. Villages were established.

33. Which of these inventions caused the MOST cultural change?

    1. The boat
    2. The wheel
    3. Iron tools
    4. The alphabet

Here is a picture of the side of a cliff where a river has cut away much rock. Different kinds of rock are marked with different patterns so that you can tell them apart. The locations of fossils are marked with capital letters. Use the picture to help you answer the question below it.



34. Fossil A is OLDER than

    1. Fossil B only.
    2. Fossils C and E only.
    3. Fossils B and D only.
    4. Fossils B, C, D, and E.

35. Suppose that there is an island on which there are 20 white rabbits and 20 brown ones. The rabbits eat the food in people's gardens, so the people try to kill as many of the rabbits as they can. They kill some rabbits of each color. However, they find that the brown rabbits, which match some of the colors in the woods, are harder to see.

    Suppose that you were to go to that island 50 years from now. Which sentence below tells what you would MOST LIKELY find on the island?

    1. There will be more brown rabbits than white ones.
    2. There will be more white rabbits than brown ones.
    3. All of the rabbits will be white.
    4. There will be about the same number of white rabbits and brown ones.

36. Four kinds of tools were used during the Paleolithic period. Their names tell us how they were made. Which of these kinds of tools was invented **first?**

    1. Chipped stone core tools
    2. Chipped stone flake tools
    3. Pebble tools
    4. Pressure-flaked tools

37. Scientists know that the early type of man called Peking Man used fire. The scientists know this because they found certain things among the remains of people of this type.

    Which of these did the scientists find?

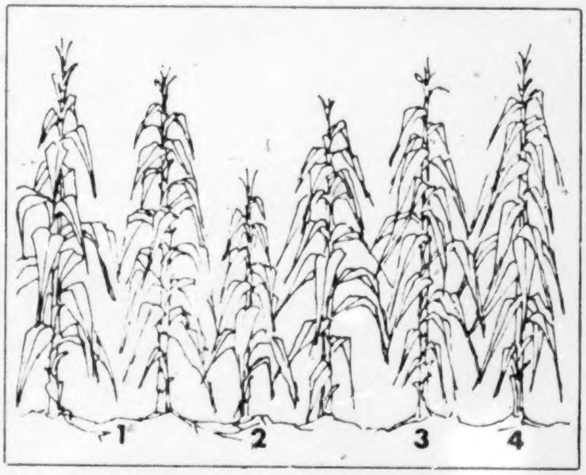
    1. Ashes, burnt bones, and the remains of fire pits
    2. Burned paper
    3. Cave pictures of people using burning torches to hunt animals
    4. Wooden spears with pointed ends which had been hardened in fire

38. Scientists think that the early type of man called Neanderthal Man may have had some kind of religious belief. The scientists think this because certain things have been found in the graves of people of this type.

    Which of these have been found in those graves?

    1. Spears and other objects to be used in a later life
    2. Pieces of stone carved with lists of the good things done by the person buried there
    3. Pieces of wood carved into the shapes crosses
    4. Drawings of people rising from their graves toward heaven

If you were standing at the edge of a field of corn so that you could see the end of each row, the plants might look like this to you. Use the picture to answer the question below it.



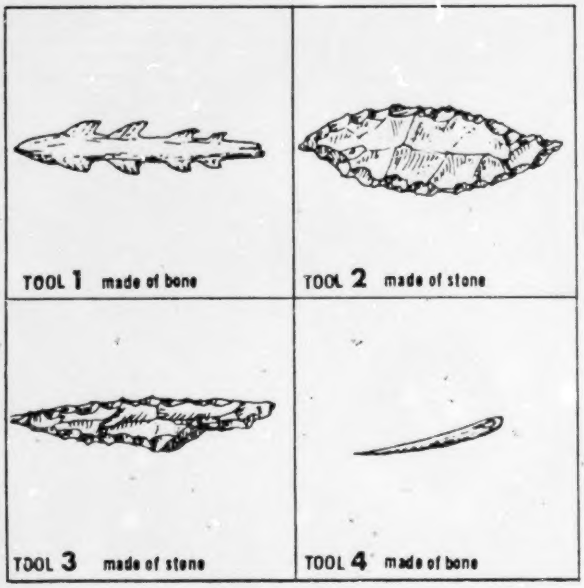
39. Suppose you believe that there is a stone wall buried underground in the field. Which of these would be the best place to dig to find the wall?

    1. Place 1
    2. Place 2
    3. Place 3
    4. Place 4

40. Which of these types of fossil men was MOST like men of today?

    1. Australopithecus
    2. Homo erectus erectus
    3. Homo erectus pekinensis
    4. Homo sapiens neanderthalensis

Here are pictures of four tools found at an Upper Paleolithic site. Use the pictures to answer the two questions below them.



41. Which of these tools suggests that people wore clothing at that time?

    1. Tool 1
    2. Tool 2
    3. Tool 3
    4. Tool 4

42. Which tool was probably used for fishing?

    1. Tool 1
    2. Tool 2
    3. Tool 3
    4. Tool 4

43. The remains of fossil men have NOT been found in

    1. Africa.
    2. America
    3. Asia.
    4. Europe.

44. Which of these is something that we CANNOT learn about prehistoric people from their artifacts?

    1. What songs they sang
    2. What tools they used
    3. What kind of clothing they wore
    4. What animals they hunted

45. Which of these is something which anthropologists CANNOT learn about a person from studying his skeleton?

    1. About how tall he was
    2. About how long ago he lived
    3. The general shape of his face
    4. The general color of his skin

46. Why was the change from hunting and gathering to food production called a "revolution"?

    1. The change took place in a very short time.
    2. People revolted against their rulers at that time.
    3. The ways of life of the people were changed
    4. There was much change in the kind of plant life at that time.

47. Two cultural developments which BEGAN with Modern Man were

    1. living in the cold north and burying the dead.
    2. living in caves and using chopper tools.
    3. making spear throwers and organizing animal drives.
    4. using flake tools and fire.

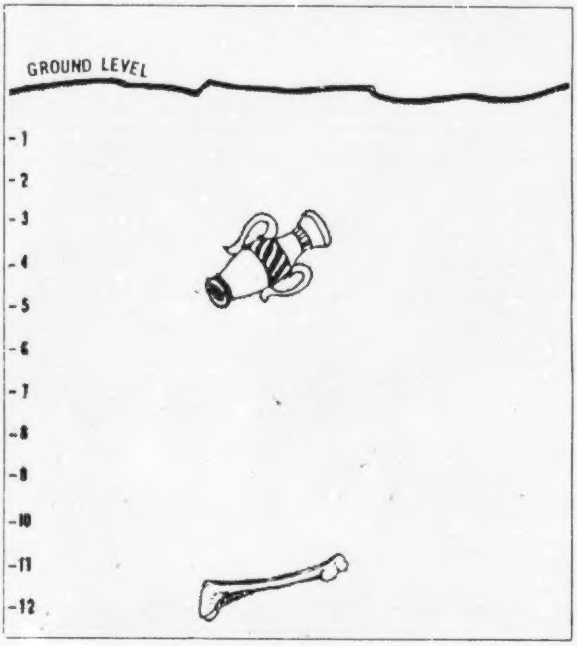
48. Four kinds of tools were used during the Paleolithic period. Their names tell us how they were made. Which of these kinds of tools was invented LAST?

    1. Chipped stone core tools
    2. Chipped stone flake tools
    3. Pebble tools
    4. Pressure-flaked tools

49. Which of these is a mutation?

    1. A mule (whose parents were a horse and a donkey)
    2. A cat with six toes on each paw (whose parents had only five toes on each paw)
    3. A white squirrel (whose mother was white and whose father was brown)
    4. A tiglon (with a mane and stripes) whose parents were a tiger and a lion

Look at the picture below. It shows a pottery vase buried four feet underground and a bone buried seven feet below the vase. These things are buried in **mud and rock**. Use the picture to answer the question below it.



50. Judging from the facts given, which of these statements is true?

    1. We can be sure that the bone was buried before the vase was.
    2. We can be sure that the vase was buried before the bone was.
    3. We can be sure that the bone and the vase were buried at the same time.
    4. It is impossible for us to tell which was buried first unless we have more information.